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Sediment Trend Study

LOS ANGELES RIVER WATERSHED

An analysis of the response of Dunsmore Canyon to check dam treatment.

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SEDIMENT TREND STUDY
L.A. RIVER FLOOD PREVENTION PROJECT
1973
ANGELES NATIONAL FOREST
CALIFORNIA REGION

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NOTE:

This study was begun by the Angeles National Forest in February, 1972, in conjunction with Management Sciences Staff, of Berkeley. Bill Kennedy was the man who helped to array the data, develop the analytical procedure, and supervised the preparation of the computer programs that are used. He also spent considerable time and effort in training Angeles personnel in the use of the computer and formatting of the data. The first draft of this study was written and submitted to the Forest by Bill. In the subsequent revisions and updates, the data has been refined a great deal and some supplemental work has also been done. But the basic concept and systems analysis have not changed much. Bill passed away Christmas, 1972, before this study was brought to final draft.

SEDIMENT TREND STUDY

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DETERMINING TRENDS OF SEDIMENT PRODUCTION
WITHIN INDIVIDUAL WATERSHEDS OF
THE LOS ANGELES RIVER WATERSHED

I. The Watershed

The Los Angeles River Watershed System (L.A.W.S.) is only a portion of the actual L.A. River Watershed. It includes only that portion which has been monitored for sediment yield. It was not established as a study area, but evolved through time as sediment trap basins were constructed. (See Appendix 4, Sec. 4, which is the list of basins and backup data.) Several concepts are essential to better understand the complex nature of this study area:

A. Validity of Debris Records

1. Annual sediment yield is, in early records, often the amount of sediment removed from the trap basin and may be a "truck count", or a surveyed measurement.
2. It may be an annual yield, or an accumulation of 2 to 7 or more years of annual yields between cleanout schedules. The zero years, therefore, may be "phantom zeros", because there may have been unmeasured inflow.
3. The cleanout was designed to restore the basin capacity, not to measure inflow, and seldom included all of the sediment deposited upstream from the basin.
4. Some basins have been surveyed, in recent years, to compute inflow, which gives an accurate reading, but also mixes accuracy within records.
5. Available records are from one year to 43 years, depending on the time since initial construction of each basin.
6. The sediment is measured from watersheds of many different sizes; of the 79 watersheds (in 1972), 58 are less than one square mile and 21 are greater:

Table 1
 SIZE OF SUBUNITS IN L.A.W.S.
 1971

LESS THAN 0.25	LESS THAN 0.50	LESS THAN 1.0	OVER 1.0	2.0 Sq.Mi. OR +	3.0 Sq.Mi. OR +	4.0 Sq.Mi. OR +
21 (27%)	42 (53%)	58 (73%)	21 (27%)	12 (15%)	6 (8%)	8 (10%)

7. The size of L.A.W.S. has not been consistent, but ranges as follows:

TABLE 2
RANGE OF SAMPLE SIZE

Water Year	Number of Basins	Area Sq. Mi.	Basins Added	Area Added
1942-43	20	33.42	0	0
44	"	"	"	"
45	23	36.30	3	2.88
46	25	37.56	2	1.26
47	26	38.07	1	0.51
48	27	38.79	1	0.72
49	28	39.19	1	0.40
1950	"	38.80	0	- 0.39
51	"	"	"	0
52	"	"	"	"
53	30	40.37	2	1.57
54	33	41.37	3	1.00
55	39	43.33	6	1.96
56	47	53.62	8	10.29
57	49	54.07	2	0.45
58	"	"	0	0
59	50	55.53	1	1.46
1960	54	61.71	4	6.18
61	55	64.33	1	2.62
62	54	63.99	- 1	- 0.34
63	"	66.41	0	2.42
64	55	66.76	1	0.35
65	60	71.54	5	4.78
66	"	71.11	0	- 0.43
67	"	70.73	"	- 0.38
68	61	71.38	1	0.65
69	67	72.61	6	1.23
1970	70	77.84	3	5.23
71	76	83.61	6	5.77
72	79	84.31	3	0.70
73	80	84.32	1	0.01

8. New basins, and hence area, are still being added and/or dropped, and will continue to be added, or deleted.

9. Some records may include sediment sluiced into them from another basin above, such as a large water impoundment.

10. These records do not include the fine sediments which have gone through the spillways. The basins with large impoundment pits, (such as Sunset Lower and Wilson), will trap a greater proportion of fine sediments than the smaller pits because of the longer route of travel. So the relative proportion of fine sediments actually trapped will vary an unknown amount.

11. Some records may be less than actual inflow if the sediment was partially sluiced out.

12. Some watersheds were begun as one basin then were replaced by two or more, and old records are therefore replaced by two or more new records.

13. Some watersheds have been partially urbanized since the record began, (See Appendix 1, Sec. 1) and their sediment yield area is thereby modified.

The function of sediment basins is to trap and desilt floodwaters, then release desilted flows to percolation beds, reservoirs, or the ocean. To maintain a safety margin and protect populated channels, each basin is cleaned out when 25% of its capacity is filled. The cost of cleanout is significant, and creates a constant need to reduce sediment yield from the watersheds in L.A.W.S. Four treatments for sediment control have been used most frequently:

1. Fire Control
2. Vegetative cover improvement
3. Road stabilization
4. Cross-channel check dams.

The effect of adverse sediment yields has been well known since the early 1900's but efforts to control sediment have been greatly intensified since 1950, through an accelerated

program in fire and sediment control. The reason for attempting to determine sediment yield trend is to help evaluate the effects of intensified treatment on the sediment problem.

B. The Debris Generation/Delivery System

The task of compiling and evaluating a good set of annual sediment yield records is further complicated by the nature of the debris generation/delivery system.

The concept of the debris generation/delivery system is illustrated by Figure A (next page). The three components of the debris generator are:

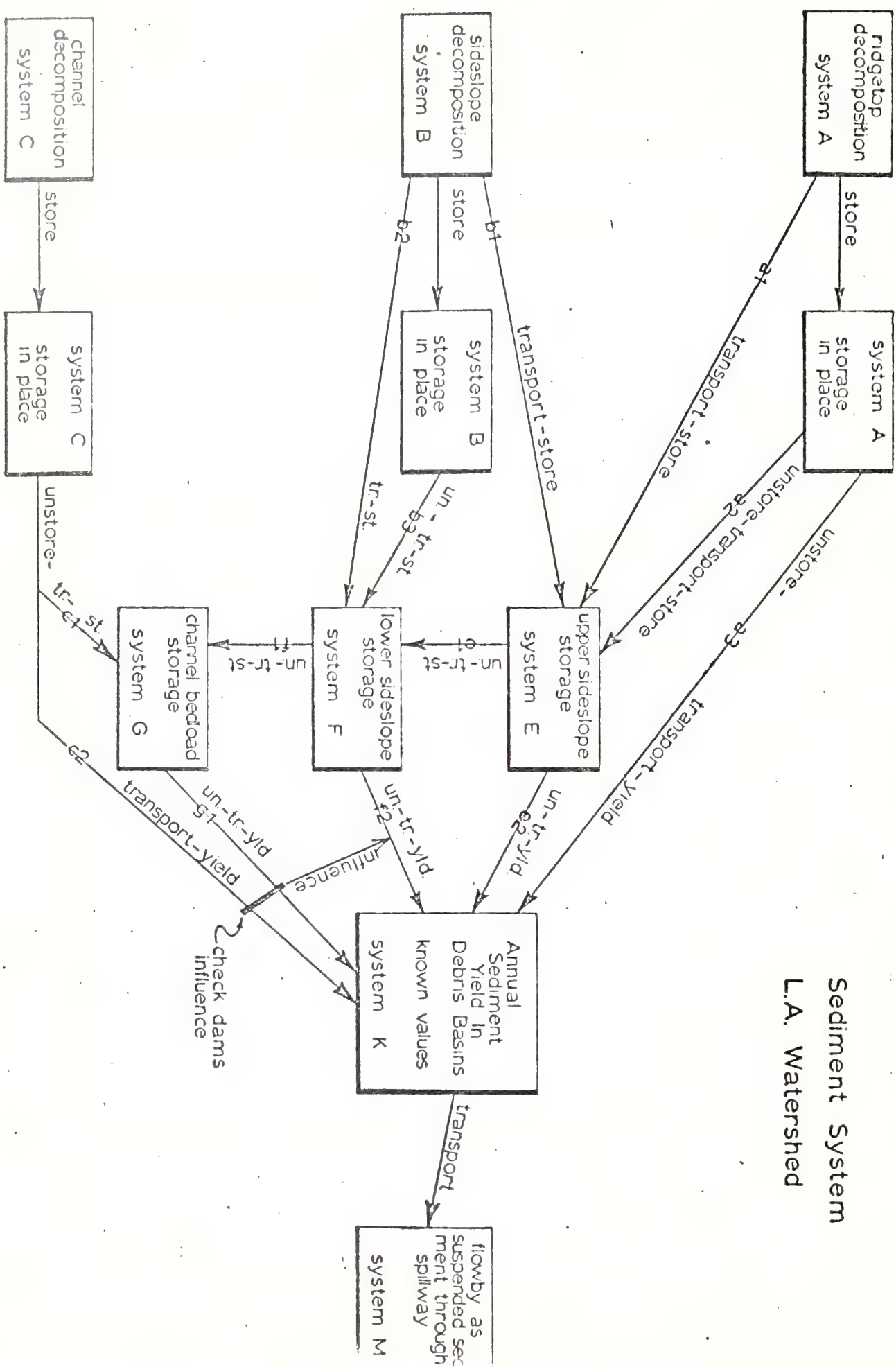
1. Ridgetops
2. Side slopes
3. Channel bottoms

These are often indistinct and not clearly defined. The debris can be stored in place, or transported to a storage site by gravity and water. The steep slopes, (often over 100%) tend to yield the debris, as it is generated, as talus or alluvium, because the gradient is too steep to hold the fragments. The results of a research study on debris movement indicates that up to 89% of the mass movement can be by gravity (called "dry creep"). (See Appendix 4.) Dry season debris movement is an important feature of the debris system because it indicates that erosion is a constant, everyday, yearlong, process and not just during the wet season. The fragments of debris are most active on steep slopes (60%+) of south aspect, which suggests that slope gradients and temperature changes are important influences. There is an annual accumulation of debris at the first break in the slope gradient, which can be the upper sideslope, lower sideslope, or the channel. Once the debris is at rest and becomes stable with time, it will require some external force to cause it to further transport; which may be:

1. Removal of plant roots that bind it in place, and/or
2. A high intensity storm, and/or
3. Undercutting from below by dry ravel, road construction, etc., and/or
4. Other disturbance.

FIGURE 1

Sediment System L.A. Watershed



The final resting place before final transport is the channel, since it has the lowest gradient of the three components of the watershed. Debris tends to accumulate in the channel for a number of years, then flushes out every few decades, in a flood. This distorts the debris yield records, because the watershed may generate debris at a constant rate, but only flush out every 30 years or more. Therefore, the debris yield potential is related to:

1. The accumulation of debris in the system.
2. The stability of the debris deposits, and
3. The magnitude of the hydrologic event.

A massive debris yield may indicate that the problem has been solved for several decades, until the right combination of flood and debris accumulation again exist. It may also mean that the sideslope storage has been released from below by movement of the bedload, and stabilization is necessary. In either case, the condition should be identified and quantified before treatment is prescribed, or the wrong treatment can be used. If a channel has a deep bedload, without gullies, and appears to be stable, it may be a prime candidate for stabilization treatment.

The significance of both debris accumulation and the influence of high magnitude floods are apparent in the debris yield records. A high magnitude flood may flush out only moderate amounts of debris, or a moderate flood can trigger catastrophic mud flows of debris. The volume of debris depends on the combination of both influences.

To compensate for the large variation in debris yields, it requires fairly long-term records. The records are analyzed as accumulating amounts to improve the correlation.

C. Need for Evaluation

The value of check dams for sediment reduction is needed now, but the systems have not been installed long enough to have been tested in a wide enough range of hydrologic events to accurately evaluate the response to treatment. Only six canyons had been treated four or more years prior to the flood of 1969.

It is important to realize that even small reductions in sediment yield are important because removal costs range \$2-\$3/cu. yd. once it is trapped in a basin, and are escalating along with the rest of the economy.

These are expensive projects to construct, and some evaluation of effectiveness is needed to evaluate the numerous proposed projects. Several attempts have been made to analyze treated and untreated watersheds to establish the benefits as a percent of the annual yield. (See Appendix 4, Sec. 3; The L.A. County Debris Reduction Study of 1959; and unpublished Forest Service studies.) From this type of study has come the general rule of thumb that a treated canyon will produce 37% less sediment annually than an untreated canyon over the stabilized reach. The 37% rule of thumb has developed through the observations and estimates that have been made to date. The basic Forest Service document which first supported this rule is Appendix 4, Sec. 3.

These types of studies leave many unanswered questions, and are not accurate enough for planning purposes. For instance, suppose the 37% rule is true on the average, but some debris yields may be reduced by 75% and others by 7%, and the average is possibly 37%. The important thing to consider, then, is the site criteria that influence a reduction, then each watershed can be evaluated on its own potential. Once the site criteria are identified and quantified, each proposed channel can be evaluated to determine its response to treatment, and the rule of thumb is not needed.

D. Factors that Influence Debris Yield

The influences that affect sediment yield can be classed as "external" to the individual watersheds, or "internal".

1. External Factors

Such things as climate, duration, and intensity of storms, etc., are external to any one watershed, and general on the entire system as a whole. They seem to have the greatest effect on annual sediment yield for any one year. The large storms of 1938, 1943, and 1969, are good examples.

Sometimes one-third, or more, of the total sediment yield for a 30-year period may be delivered by a single storm event, as in 1969, (Pickens, Rubio, Brand) the external influences are not subject to control by man, we can only prepare to control the results with structural works. The erratic cycles of external influences make them unpredictable and difficult to manage.

2. Internal Factors

Such influences as vegetal cover, topography, fire, slope, ground cover, etc., are internal, and associate to make each watershed a unique individual unit, with unique functions. Except for large burns, the influences are fairly stable annual factors, and therefore do not induce much fluctuation in the sediment system. Man can adjust and modify these factors to some extent, depending on the amount of investment he wants to make. Wildfire and landslips are the biggest problems because they both release temporary storage to channels for further transport. A good example of the response to fire is Brand Canyon (treated), and Sunset Canyon (untreated). Both were burned 100% on the same day, 3/1964. Brand produced more sediment the first year after the burn than it had yielded in the previous 20 years; then yielded 3.4 times the 21-year amount the following year, and in the six years after the burn, the total accumulated yield was 14.2 times its 20-year prefire record. Sunset Canyon doubled its previous 36 years of records the first year, and tripled it in the following 6-year period. In this event there was some interaction between external and internal factors.

II. The Evaluation

A. The Components of Comparability.

In comparing sediment yield per year, per unit of area, of individual watersheds, we can relate the performance of each individual watershed in the system to the total system (LAWS). By accumulating the annual yield from an average watershed, we can build in a certain amount of correlation to the data, and compensate for the years when there was some inflow, but no measurement. The "average" watershed is one square mile on both L.A.W.S. and the canyon being

related to LAWS. With L.A.W.S. as the standard, or norm, we can compare each subwatershed to the same value, in the same unit of measurement, and thereby show its relative functions for the period of records.

This correlation is expected to compensate for some external effects, (since they are an influence in both L.A.W.S. and the test canyon) and some internal effects (if an adequate time of calibration precedes both the channel treatment and external influence).

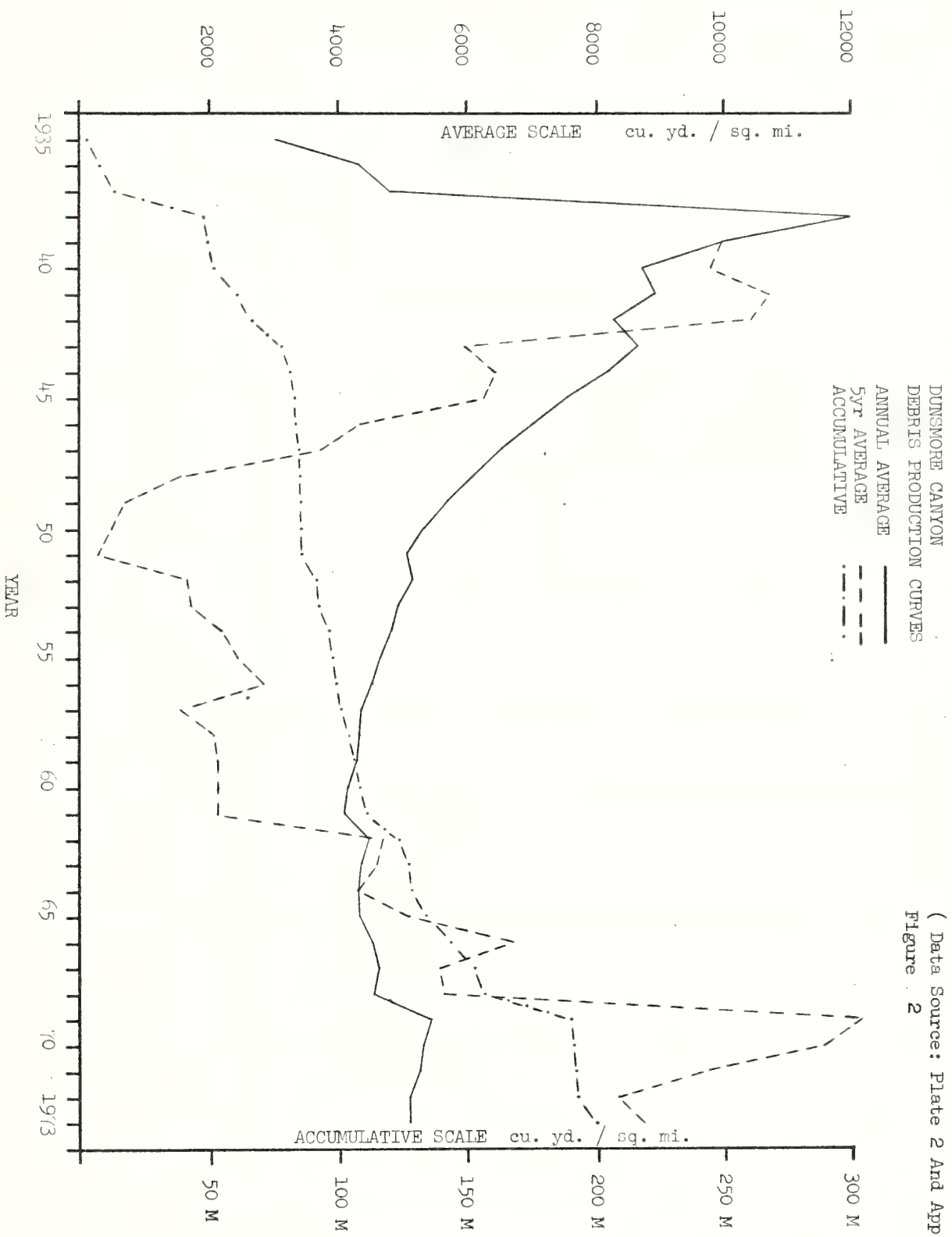
In the process of analyzing several mass sediment yield curves, it is observed that there is an apparent cycle for the period 1944 - 1969. (See curves Appendix 1, Sec. 2.)

A comparison of the running mean curves for L.A.W.S. debris yield and runoff water to the ocean also indicated an identical cycle. This suggests that both sediment and floods have followed a similar pattern, or in other words, it is a weather-influenced cycle. Since there is a similar curve for both parameters, and the time span is identical, it adds considerable confidence to the premise that this is a definite cycle of events.

All of the debris analysis is confined to this identified cycle period and later years, even though records may have existed prior to the cycle. There are 20 watersheds, consisting of 33+ square miles of area that have records for the entire 26-year cycle, 1944-1969. (See Appendix 1, Section 4).

B. The Comparable Watershed

Using Dunsmore watershed, which was treated with check dams in 1964, as an example we can describe its response to treatment. This 0.84 square mile watershed includes a number of the problems previously discussed on inaccurate inflow records. The mass curve, Figure 2, shows the typical sediment cycle, and the data table, Place 2, Col. 4, shows several zero years followed by the accumulated amount. The data for L.A.W.S. does not have zero years because so far there has always been some yield somewhere on the watershed. The analysis of this data is as follows:



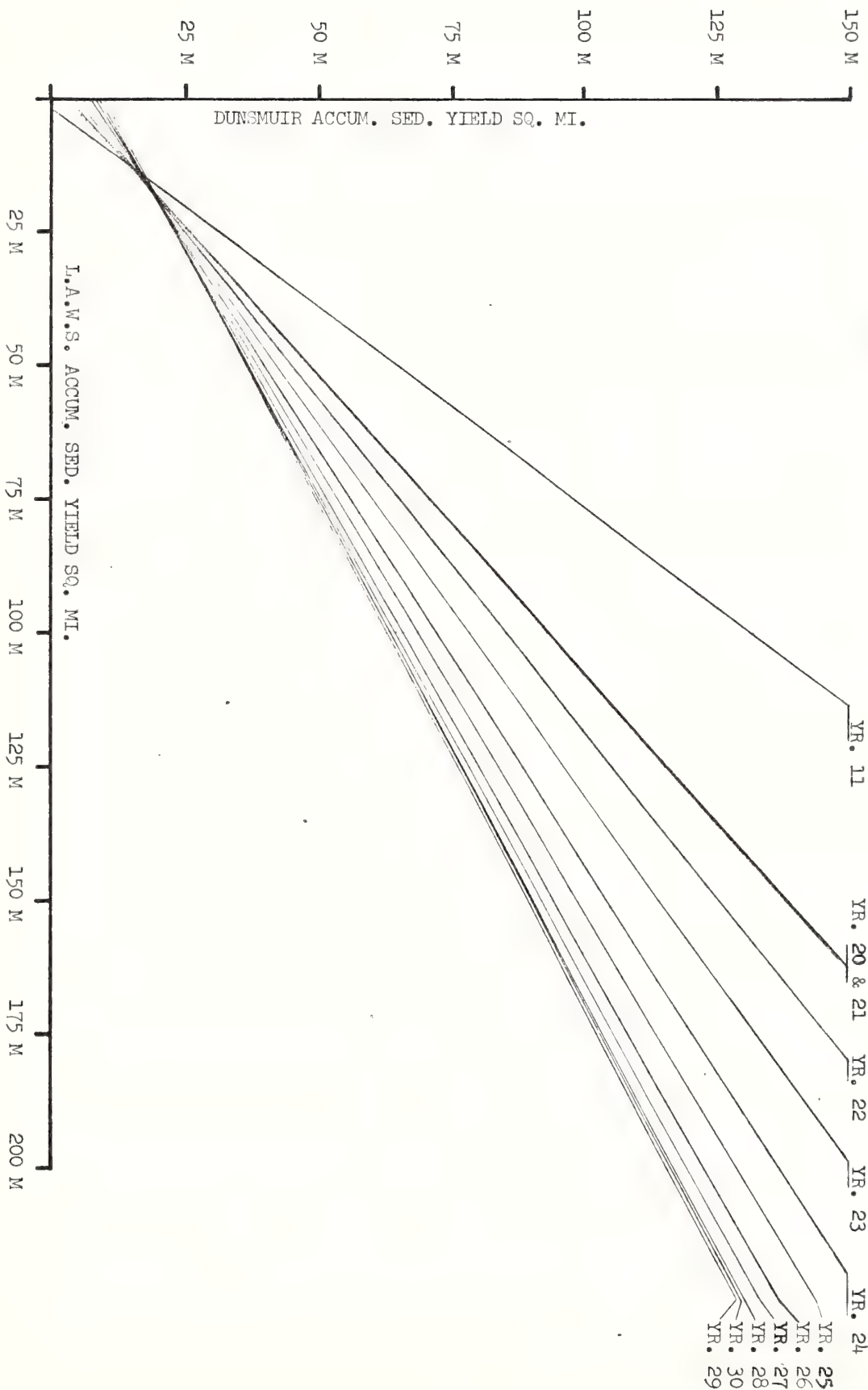
(Data Source: Plate 2 And App. 6)
 Figure 2

PLATE 2. Sediment Records - Dunsmore Canyon 0.84 Miles

N	1 Water Year	2 Annual Cleanout (Cu.Yds.)	3 Col. 2 Accum.	4 Yield (Cu. Yd./Sq.Mi.) Col.2-0.84	5 Column 4 Accum.	6 Running Mean Col.5-N	7 Correlate Coeff. "r"	8 Regress. Coeff. "a"	9 Regress. Coeff. "b"	10 LAMS Accum. (C.Y./ Sq.Mi.)	11 Running Mean Col.10-N
1	1943-44	3888		4628	4628	4628				4231	4231
2	1944-45	766		911	5539	2770				4231	2798
3	1945-46	2204		2623	8162	2721				5597	2142
4	1946-47	0		0	8162	2040				6426	1853
5	1947-48	0		0	8162	1632				7413	1540
6	1948-49	0		0	8162	1360				7701	1308
7	1949-50	0		0	8162	1166	.9235	535.11	1.000	7849	1143
8	1950-51	0		0	8162	1020	.9225	718.64	0.9664	8000	1003
9	1951-52	11025		13125	21287	2365	.9815	-2896.51	1.5050	8027	1724
10	1952-53	0		0	21287	2129	.9893	-2800.50	1.4910	15514	1624
11	1953-54	0		0	21287	1935	.9819	-1662.49	1.3350	16245	1712
12	1954-55	0		0	21287	1774	.9761	-839.78	1.2262	18834	1671
13	1955-56	1184		1409	22696	1746	.9729	-151.59	1.1412	20050	1705
14	1956-57	3600		4285	26981	1927	.9789	-250.42	1.1530	22162	1659
15	1957-58	4692		5585	32566	2171	.9832	-620.70	1.1930	23220	1761
16	1958-59	0		0	32566	2035	.9856	-318.95	1.1628	26421	1845
17	1959-60	0		0	32566	1912	.9857	59.97	1.1262	29518	1816
18	1960-61	2168		2580	35146	1953	.9874	242.75	1.1093	30873	1811
19	1961-62	2829		3367	38513	2027	.9661	2323.75	0.9524	32594	2450
20	1962-63	3908		4652	43165	2158	.9679	3076.43	0.8974	46545	2471
21	1963-64	0		0	43165	2055	.9691	3608.16	0.8952	49424	2421
22	1964-65	0		0	43165	1962	.9651	4405.08	0.8060	50843	2555
23	1965-66	0		0	43165	1877	.9496	5799.17	0.7225	56212	2884
24	1966-67	2000		2380	45545	1898	.9388	7035.81	0.6535	66326	3103
25	1967-68	600		714	46259	1850	.9342	8737.56	0.6078	74472	3302
26	1968-69	17300		20595	66854	2571	.9467	9128.98	0.5699	77548	4301
27	1969-70	~1100		1309	68163	2525	.9559	9387.85	0.5527	113996	4222
28	1970-71	0		0	68163	2434	.9619	9571.02	0.5414	115159	4113
29	1971-72	0		0	68163	2350	.9661		0.5335	115856	3995
30	1972-73	7216		8590	76753	2558	.9710	9462.09	0.5380	121198	4040

DUNSMUIR CANYON REGRESSION CURVES
 ACCUMULATIVE SEDIMENT AS PREDICTED BY L.A.W.S

(Data Source: Plate 2)
 FIGURE 3



1. We correlate the two mass yield data, (Col. 5 and 10, Plate 2) with a single regression analysis. Regression is with L.A.W.S. on the X-Array, and Dunsmore in the Y-Array of data, for the years 1944-1973, 1944-72 and so on to years 1944-64 then for alternate years. (See Appendix 2, Sec. 1).

2. The regression line (solution of $Y=A+BX$) is plotted through the scatter of points for each period of record, as shown on Figure 3. This line is the "best fit" to the two sets of data.

3. These regressions were determined by the computer program *SIREG* developed by Management Sciences Staff, Berkeley. The results are shown in Columns 7, 8, and 9 of Plate 2.

4. The regression lines (Fig. 3) indicate the performance of Dunsmore watershed in relation to the performance of the whole watershed system. If the line is steeper than 45 degrees (which is a 1:1 ratio), then Dunsmore exceeds L.A.W.S., and if it is less than 45 degrees, then Dunsmore underproduced L.A.W.S.

C. Results of the Analysis

The regression analysis indicates that:

1. For the first 21 years of the period of comparability, Dunsmore correlated strongly with L.A.W.S., (correlation coefficient 0.97).

2. The 21-year regression line is almost identical to the 20-year regression line. At year 11 and before, there is insufficient data to develop a good correlation.

3. We can say then, with a considerable degree of confidence, that Dunsmore performed similar to L.A.W.S. in sediment yield for the 21-year period, 1944 - 1964.

4. In 1965, (year 22) there was a significant shift downward in the slope of the regression lines (indicating a diminished amount of debris inflow to the basin at the

mouth of the canyon) and a continued annual additional shift for the next 7 years of record, although it was progressively less each year.

5. The downtrend appears to have leveled off in year 29, (1972) and perhaps began a slight uptrend in year 30.

6. The downward shift in the slope of the line continued in spite of a major flood event in 1969 (year 26).

The definite change in the slope of the regression line occurs the next year after the check dams were installed. This would suggest that, after 21 years of consistently strong correlation, that the abrupt shift in the regression line (at year 22) is due to the performance of check dams that were installed the previous year, and they have indeed reduced the sediment yield. The next question is, how much?

D. The Magnitude of the Response to Treatment

To estimate the change in yield, it is first necessary to compute how much sediment would have been produced without the structures, compare it with the actual yield, and take the difference. The output for each regression also included the formula of a straight line equation which best fits the data.

The first 21 years of record are used to establish a trend between L.A.W.S. and Dunsmore. The trend can then be projected for 9 years to predict the accumulated debris yield for Dunsmore by 1973, on the basis of the accumulated yield for L.A.W.S. (See Appendix 2, Years 1944-64).

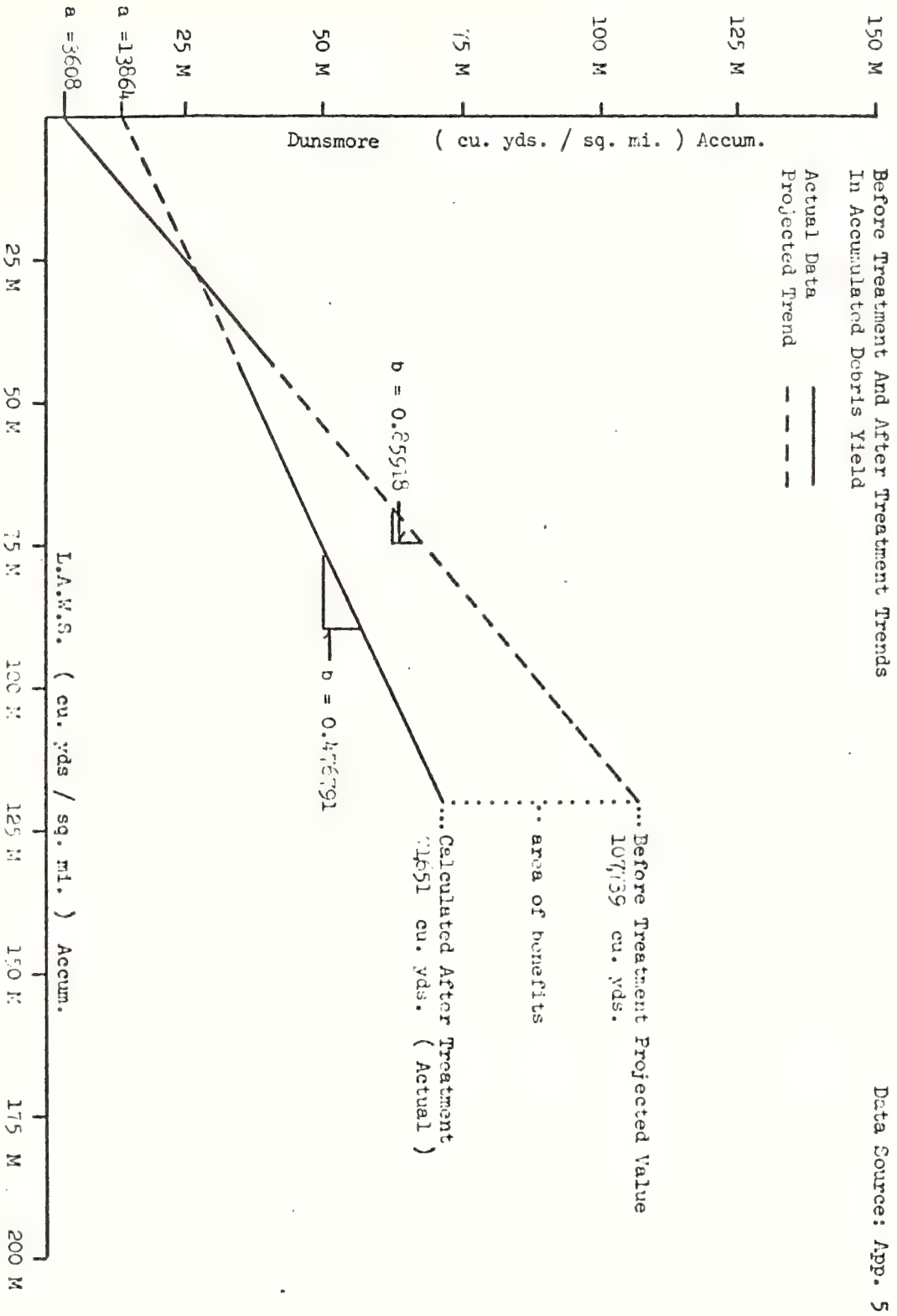
$$\begin{aligned} Y &= a+bX \\ &= 3608 + 0.859179 (121,198) \\ &= 107,739 \text{ cu. yds./sq. mi.} \end{aligned}$$

Where: Y = Dunsmore, accumulated debris per sq. mi. in year 1973

a+b = regression coefficients from Fig. 1

X = the accumulated debris yield of L.A.W.S. per sq. mi. in 1973. (See Plate 2)

Fig. 4



This means that Dunsmore would probably have yielded an accumulated volume of 107,739 yards without the check dam construction. The actual accumulated yield for Dunsmore, with the check dams, is computed with the "after treatment" equation. (See Appendix 2, Years 1964-73).

$$\begin{aligned} Y &= a+bX \\ &= 13,864 + 0.476791 (121,198) \\ &= 71,651 \end{aligned}$$

The difference is the benefits of check dam treatment:

$$107,739 - 71,651 = 36,088 \text{ cu. yds./sq. mi. in the average watershed, or:}$$

$$36,088 \text{ cu. yds./sq. mi. (0.84 sq. mi.)} = \underline{30,314} \text{ cu.yds.}$$

reduction in the accumulated debris yield. The total debris yield for the watershed is:

$$\begin{aligned} &28,216 \text{ cu. yds. (inflow to the basin) } 48\% \\ + &\underline{30,314} \text{ cu. yds. (reduction) } 52\% \\ &58,530 \text{ cu. yds.} \end{aligned}$$

The 52% reduction in debris yield is certainly a significant amount. The change in the regression lines resulting from check dam treatment are illustrated in Figure 3. Figure 4 illustrates the shift in the trend of the debris yield and also the relationship of the regression coefficients.

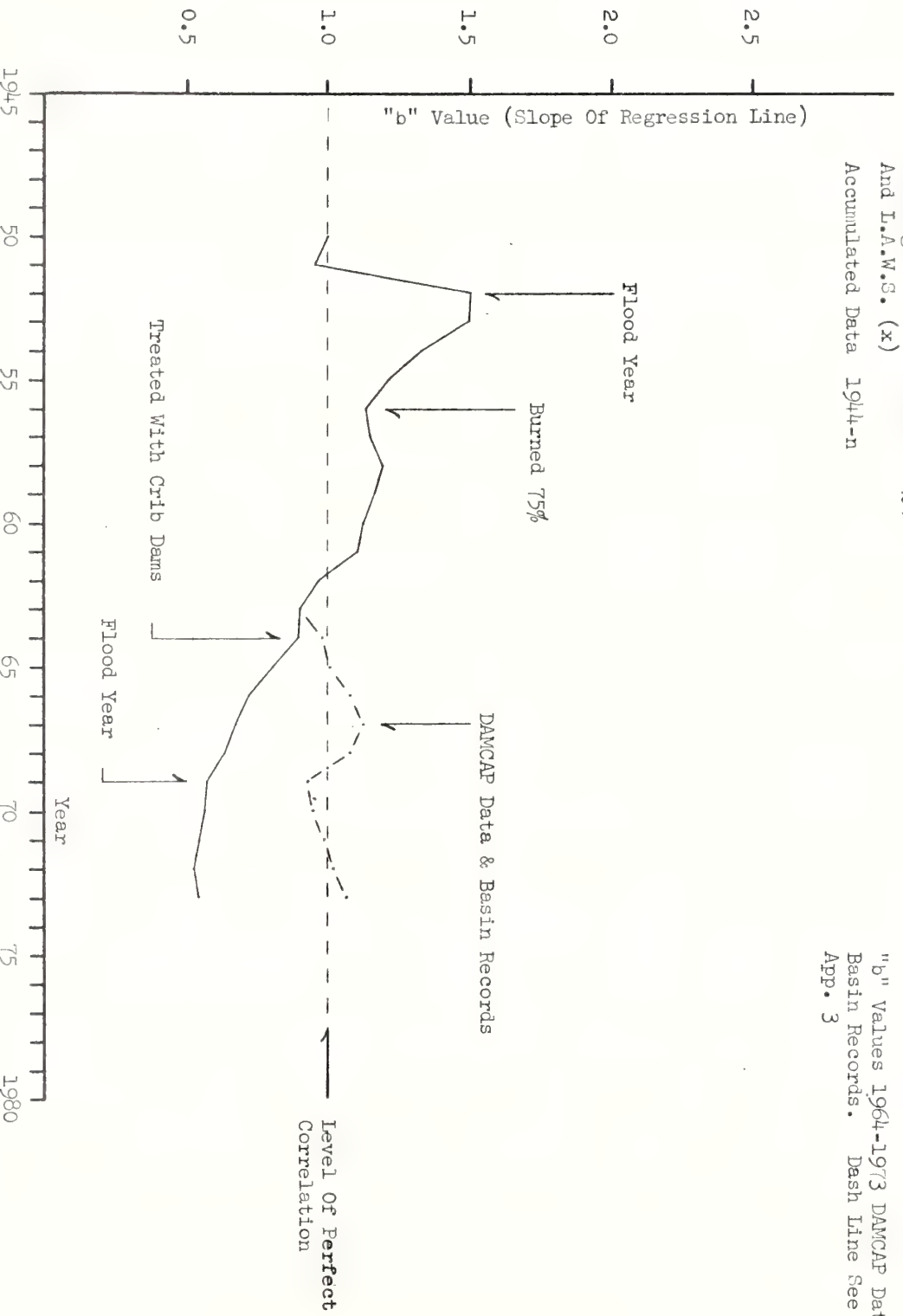
The slope of the regression line is the "b" coefficient. Each time the correlation between L.A.W.S. and Dunsmore changes, the "b" value will change. Fig. 5 is a plot of the "b" value, to illustrate the definite change that was caused by check dam installation.

E. Debris Storage in the System

Also shown in Figure 5 is the plot of "b" values of linear regression with debris storage in the check dam system included. To obtain this value, the volume of debris above each check dam is calculated, using the computer model DAMCAP. The data is then tested for comparability with a random t-test and a paired data t-test. In both t-tests the

FIGURE 5

Sediment Trend Study
Values Of "b" Coefficient
For Regression Of Dunsmore (y)
And I.A.W.S. (x)
Accumulated Data 1944-n



Data Source:
"b" Values 1950-1973 Solid Line
See Plate 2
"b" Values 1964-1973 DAMCAP Data &
Basin Records. Dash Line See
App. 3

results show that the debris yield of L.A.W.S. and Dunsmore + DAMCAP are similar populations. (See Appendix 3).

The regressions indicate that when check dam storage is included in the debris yield record, there has been no significant change over pretreatment yields. There may be a slight increase in debris yield but it is not statistically significant.

The Dunsmore Canyon check dam system is now filled to 110% of its capacity, with a large overload on the upper structures. The November, 1973 survey reveals that the debris cones of several dams have backed up on the next higher dam:

<u>Dam #</u>	<u>Depth of Cone</u>
4	3 feet on sill of #5
5	1 foot on sill of #6
8	9 feet overload in debris drifts
9	15 feet overload in a debris drift

Conversely, the other debris cones are not yet mature (See Table 3 below) as of 1973. The volume of debris in each check dam system is computed with the computer program DAMCAP, which was developed and written by Management Sciences Staff, Berkeley. The method needs to be refined to improve its accuracy. (DAMCAP printout is in App. 3.)

The dams in this system were located by use of the rule-of-thumb that the debris cone will mature on a gradient which is $7/10$ of the original channel gradient. The rule has not proven to be very accurate on other channel projects, and is not supported by the study of Dunsmore debris cones. The cones apparently mature on a gradient greater than level, but how much is still to be determined.

PLATE 2. Sediment Records - Dunsmore Canyon 0.84 Miles

N	1	2	3	4	5	6	7	8	9	10	11
	Water Year	Annual Cleanout (Cu.Yds.)	Col. 2 Accum.	Yield (Cu. Yd./Sq.Mi.) Col.2-0.84	Column 4 Accum.	Running Mean Col.5-N	Correlate Coeff. "r"	Regress. Coeff. "a"	Regress. Coeff. "b"	LAWS Accum. (C.Y./ Sq.Mi.)	Running Mean Col.10-N
1	1943-44	3888		4628	4628	4628				4231	4231
2	1944-45	766		911	5539	2770				5597	2798
3	1945-46	2204		2623	8162	2721				6426	2142
4	1946-47	0		0	8162	2040				7413	1853
5	1947-48	0		0	8162	1632				7701	1540
6	1948-49	0		0	8162	1360				7849	1308
7	1949-50	0		0	8162	1166				8000	1143
8	1950-51	0		0	8162	1020				8027	1003
9	1951-52	11025		13125	21287	2365				15514	1724
10	1952-53	0		0	21287	2129				16245	1624
11	1953-54	0		0	21287	1935				18834	1712
12	1954-55	0		0	21287	1774				20050	1671
13	1955-56	1184		1409	22696	1746				22162	1703
14	1956-57	3600		4285	26981	1927				23220	1659
15	1957-58	4692		5385	32566	2171				26421	1761
16	1958-59	0		0	32566	2035				29518	1845
17	1959-60	0		0	32566	1912				30873	1816
18	1960-61	2168		2580	35146	1953				32594	1811
19	1961-62	2829		3367	38513	2027				46545	2450
20	1962-63	3908		4652	43165	2158				49424	2471
21	1963-64	0		0	43165	2055				50843	2421
22	1964-65	0		0	43165	1962				56212	2555
23	1965-66	0		0	43165	1877				66326	2884
24	1966-67	2000		2380	45545	1898				74472	3103
25	1967-68	600		714	46259	1850				77548	3102
26	1968-69	17300		20595	66854	2571				111828	4301
27	1969-70	1100		1309	68163	2525				113996	4222
28	1970-71	0		0	68163	2434				115159	4113
29	1971-72	0		0	68163	2350				115856	3995
30	1972-73	7216		8590	76753	2558				121198	4040

TABLE 3. Storage of Debris, Dunsmore Canyon
(Cubic Yards)

DAM NO.	1	2	3	4	5	6	7	8	9	Tot.
DESIGN	6700	4500	3000	6100	5300	7900	23100	10400	5600	72600
Date/Yr.	2/64	2/64	2/64	2/64	3/64	2/64	3/64	6/64	5/64	
1964	227	547	407	1321	1211	2335	6159	3485	1739	17431
%	3%	12%	14%	22%	23%	30%	27%	34%	31%	24%
66	1814	1647	1004	2597	2324	3966	12825	5565	3030	34773
%	27%	37%	33%	43%	44%	50%	56%	54%	54%	48%
10/71	4473	2833	2004	5916	5135	5356	18171	11803	8710	64402
%	67%	63%	67%	97%	97%	68%	79%	113%	156%	89%
11/73	5030	2962	2819	7486	5753	5588	20636	15330	14296	79900
%	75%	66%	94%	123%	109%	71%	89%	147%	255%	110%

Note in Table 3 that the dams were all constructed in the spring of 1964, with very little inflow that year. Therefore the storage for 1964 is not an inflow volume, but is the backfill as part of construction. In addition to the backfill will be the access road grade, undercut side slopes, etc., that normally flush out the first storm year after construction. Since backfill is 24% of the storage capacity of the system, the total construction-induced debris will be at least 32%, or 23,235 cu. yds. Several other things can be noted about this table:

1. The upper dams appear to fill first, which may suggest that the source of the most massive debris movement is from above the check dam system rather than from adjacent sidewalls, or the immediate channel.

2. The entire check dam system is not filled, but some are over and some is under the design amount.

3. The overload volume may be unstable to the point that it will later be flushed out.

4. The system is now 9 years old, but is not yet filled, or stable, and seems to be constantly changing.

5. Each debris cone has consistently aggraded, and not one has yet degraded.

The actual debris trapped is the present volume minus construction-induced debris:

$$79,900 \text{ cu. yds.} - 23,235 \text{ cu. yds.} = 56,665 \text{ cu. yds.}$$

This value is significant, in that it is a greater volume than was predicted by the preceding regression analysis, by 26,351 cu. yds. (87%). That is:

$$56,665 \text{ cu. yds.} - 30,314 \text{ cu. yds.} = 26,351 \text{ cu. yds.}$$

The significance is that virtually the entire volume that can be claimed as a reduction in the debris yield can also be accounted for in storage and overload on the debris cones. The overload is:

Dam #4	-	1386.	cu. yds.
#5	-	453.	cu. yds.
#8	-	4,930	cu. yds.
#9	-	8,696	cu. yds.
Sum		15,465	cu. yds.

The overload may or may not be a threat, because it is based on the design rule-of-thumb that the cone gradient will be 7/10 of original channel gradient. The rule-of-thumb has never been proven accurate. In this case, however, it is the best we have. Had the overload been yielded instead of stored it would have lowered the debris reduction benefit to 20% instead of 52%.

III. Summary

This evaluation of the effectiveness of a crib dam system as a debris control treatment is based on the comparison of Dunsmore Canyon debris yield to a norm, before and after treatment. There are 21 years of debris basin records before and 10 years after treatment. In order to minimize the variation of records, the data is accumulated for an average watershed (1 sq. mi.) for both the norm and the test canyon. This method of evaluation can be used on other watersheds that are treated with debris control structures, to determine the response to treatment. The conclusions of this study are:

1. In the 10 years following crib dam construction, the accumulated debris yield at the basin has been 52% less than was expected.
2. The reduction in debris yield can all be accounted for as storage accumulation above the check dams, and therefore the reduction is apparently a temporary condition.
3. In the last year of debris records, the trend has apparently began to return to the normal, pretreatment level.
4. When all of the system storage is included, there has been a slight but statistically insignificant increase in debris yield over the amount expected.
5. The check dam system did not trap 100% of the debris yield at any time in its history, as was expected in pretreatment evaluation.

6. Construction-induced debris and backfill take up 32% of the original system storage potential.

7. There is an apparent overload of debris on the cones of dams 4, 5, 8, and 9, as much as 155% over the designed amount.

8. The rule of thumb that, "the debris cone gradient will assume a profile 7/10 of the original channel gradient", cannot be supported by this study. The overloaded debris cones tend to disprove this theory.

9. The rule of thumb that "the stabilized reach will show a 37% reduction in debris yield" cannot be supported by this study.

10. There is no apparent permanent reduction in the debris yield due to check dam treatment.

APPENDIX 1

- Section 1 - Watershed History
- Section 2 - Mass Curves of Debris Yields
- Section 3 - Running Mean of Wastewater to the Ocean
Running Mean of Annual Debris Yield
- Section 4 - Summary of All Canyons with Debris Records 1944+

APPENDIX 1

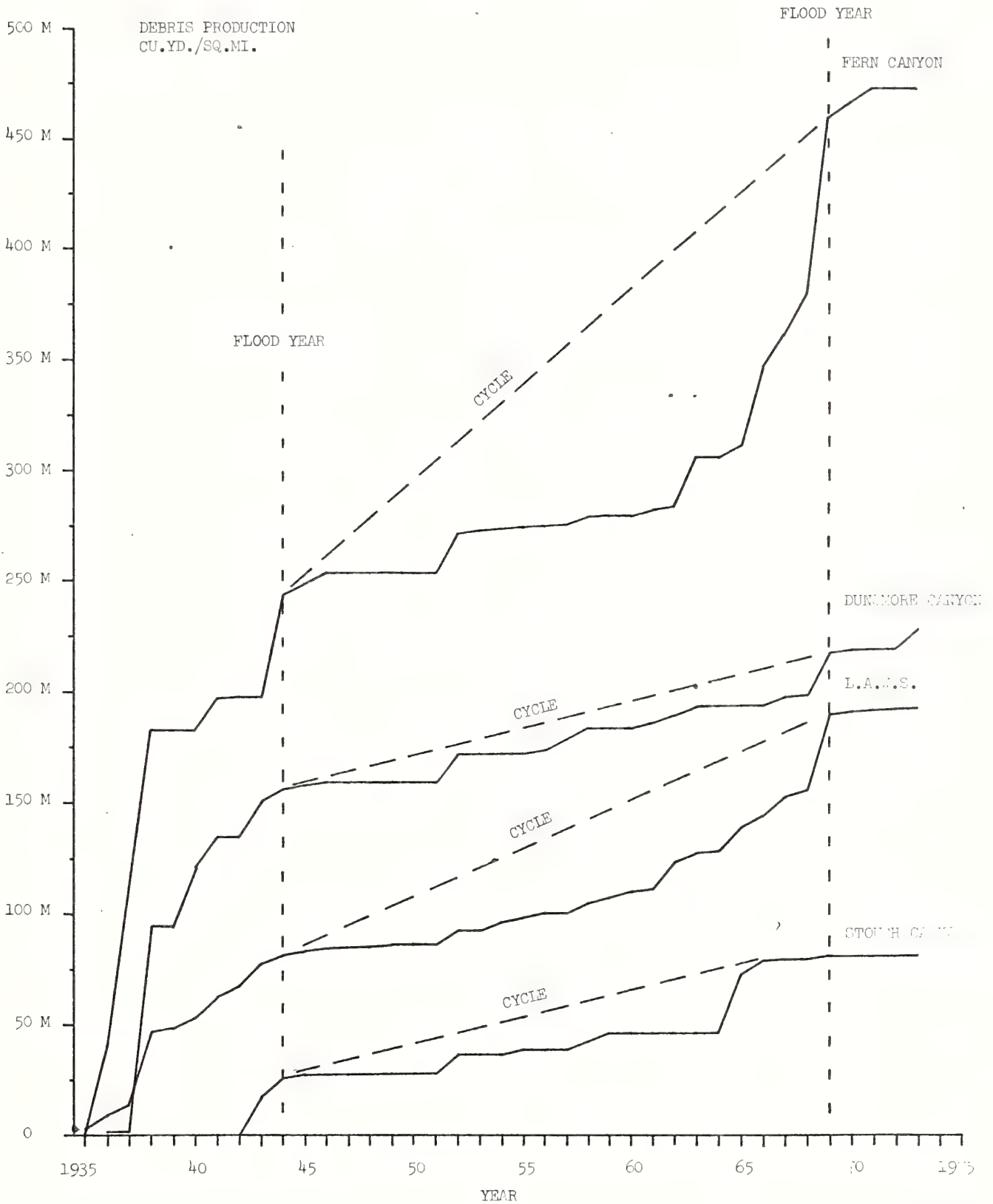
WATERSHED HISTORY

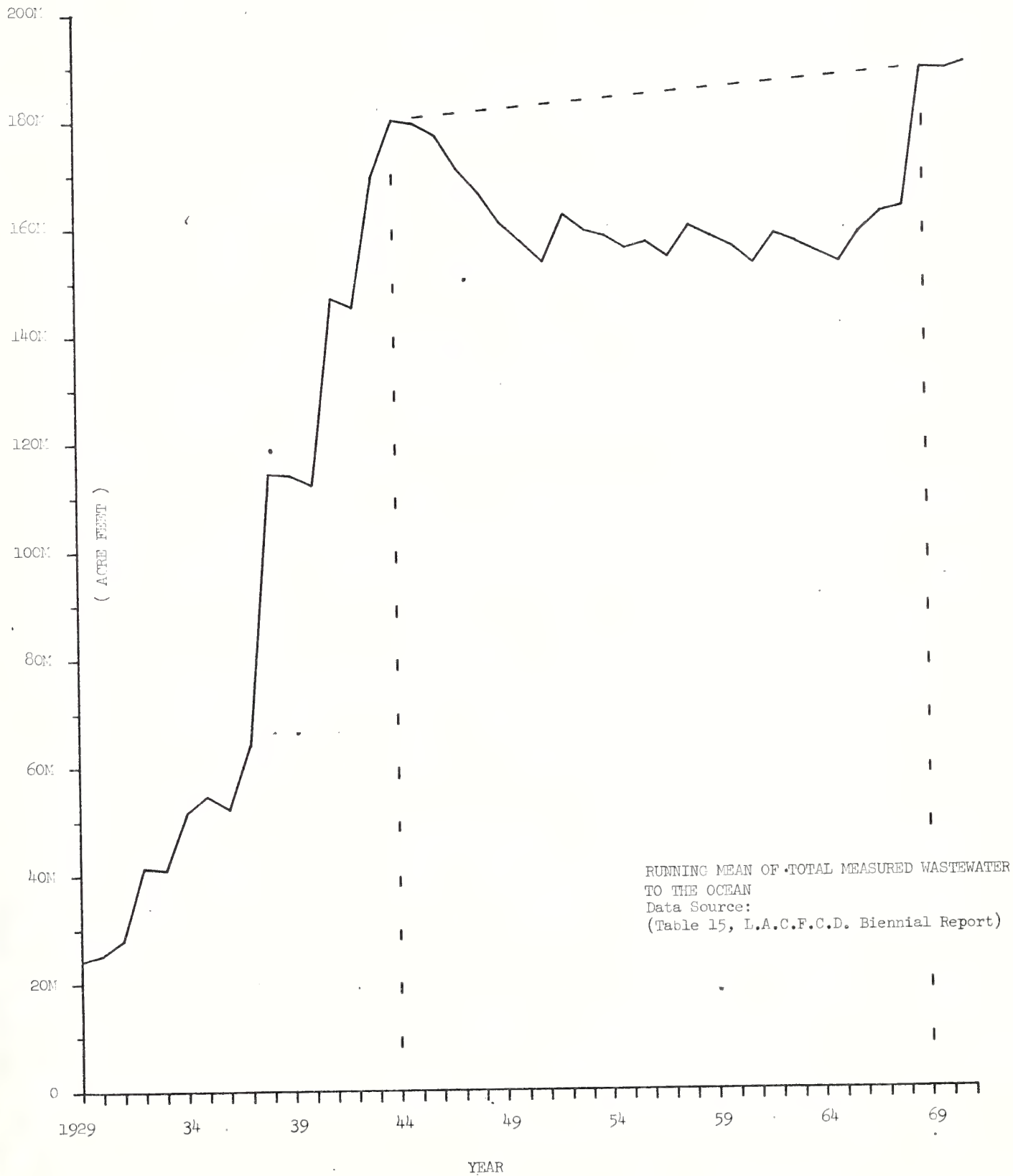
LOCATION	SEDIMENT TRAP BASIN	ORIGINAL AREA	1972 AREA	TREAT DATE	BURN/%
Sylmar	Sombrero	1.06 sq.mi.	-	1963	
	Stetson	0.29	-	-	
	Hog	0.30	-	-	
	Schoolhouse	0.28	-	1968	
Verdugo	Brand	1.03	-	1949	
	Childs	0.31	-	-	
	Deer	0.59	-	-	
	Elmwood	0.31	-	-	
	Hillcrest	0.35	-	-	
	Sunset Lwr.	0.65	-	-	
	Sunset Up.	0.44	-	-	
Tujunga La Canada	Blanchard	.50	-		
	Blue Gum	.19	-		
	Cooks	.58	-	1956	
	Dunsmore	.84	-		
	Eagle	.61	0.44		
	Gould	.47	0.36		
	Haines	1.53	-		
	Halls	1.06	0.83	1956	
	Hay	0.20	-	1968	
	Pickens	1.84	1.56		
	Rowley	0.58	0.47		
	Shields	0.27	0.21		
	Snover	0.23	-		
	Verdugo	9.97	3.25		
	Ward	0.10	-	1963	
	Winery	0.18	-		
	Zachau	0.38	0.31(11%)		
Altadena	Fair Oaks	0.21	.07(67%)		
	Fern	.30	.28(7%)		
	Las Flores	.45	.40(11%)	1966	
	Lincoln	.50	.50		
	Rubio	1.26	1.19(6%)		
	West Ravine	.25	.20(20%)		

APPENDIX 1 (Cont'd.)

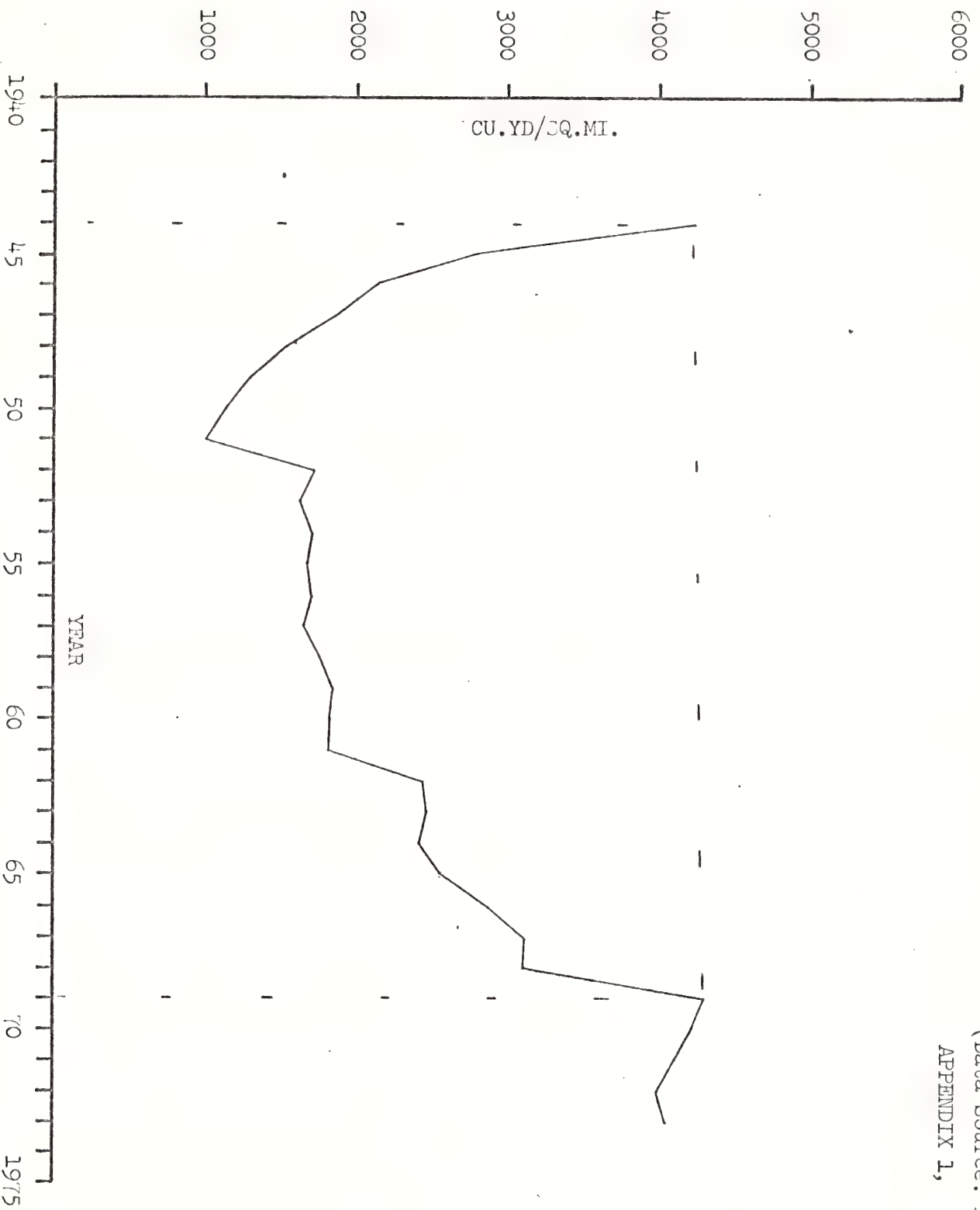
LOCATION	SEDIMENT TRAP BASIN	ORIGINAL AREA	1972 AREA	TREAT DATE	BURN/%
Sierra Madre Monrovia	Auburn	.19	-		1954-80%
	Bailey	.60	-		61-85%
					1954-100%
	Bradbury	.68	-		61-35%
					1953-55%
					58-100%
	Carriage Hse	.03	-		
	Carter	.12	-		1954-90%
					61-95%
	Kinneloa E.	.16	-		
	Lannan	.25	-		1954-100%
	Waddock	.25	-		1953-90%
					58-100%
	Ruby	.28	-	1967	
	Santa Anita	1.70	-	1965	
	Sawpit	2.84	-	1965	
Azusa	Sierra M.	2.39	-		
	Sierra M.V.	1.46	-		
	Spinks	.44	-		
	Sturtevant	.03	-		
	Sunnyside	.02	-		
Claremont	Beatty	.20	-		1946-90%
					68-
	Englewild	.40	-		1960-100%
	Harrow	.43	-		1968
	Hook E.	.18	-		1968
	Hook W.	.17	-		1968
	Little				1919-100%
	Dalton	3.31	-		1968

APPENDIX 1, SEC 2
MASS CURVES OF DEBRIS YIELD





RUNNING MEAN OF ANNUAL DEBRIS YIELD
OF L.A.W.S. 1944-1973
(Data Source: Plate 2, Col. 11)
APPENDIX 1, SEC 3



SUMMARY OF ALL CANYONS WITH DEBRIS BASIN RECORDS IN YEARS 1943-44. THE LOCATION (LA = LA RIVER, SO = SAN GABRIEL) AND YEARS OF RECORD ARE ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(1) L.A.-U.S. SUMMARY	(2) BRAND LA 1936-	(3) DUNSMORE LA 1935-	(4) EAGLE LA 1937-	(5) FAIRDAKS LA 1936-	(6) FERN LA 1936-	(7) HATHES LA 1937-	(8) HALLS LA 1936-
1944	4231.00	312.00	4023.00	7413.00	2495.00	4539.00	4182.00	7793.00
1945	1360.00	.00	911.00	1730.00	2752.00	4920.00	.00	4789.00
1946	829.00	.00	2623.00	441.00	4517.00	4440.00	341.00	1613.00
1947	967.00	133.00	.00	659.00	3147.00	723.00	602.00	4206.00
1948	255.00	.00	.00	115.00	28.00	.00	.00	.00
1949	140.00	.00	.00	.00	.00	.00	.00	.00
1950	171.00	.00	.00	.00	.00	.00	.00	.00
1951	27.00	.00	.00	.00	.00	.00	.00	.00
1952	7437.00	5156.00	13125.00	4446.00	16704.00	17990.00	4024.00	20647.00
1953	731.00	.00	.00	4096.00	.00	.00	.00	.00
1954	2509.00	.00	.00	.00	.00	1533.00	2306.00	3122.00
1955	1210.00	.00	.00	.00	.00	1333.00	.00	3712.00
1956	2112.00	.00	.00	.00	.00	.00	.00	.00
1957	1053.00	.00	.00	.00	.00	3703.00	7061.00	11473.00
1958	5241.00	1376.00	5507.00	2307.00	10009.00	5500.00	350.00	1483.00
1959	5497.00	.00	.00	2157.00	9837.00	.00	.00	.00
1960	1355.00	.00	.00	.00	.00	2433.00	.00	3914.00
1961	1721.00	1614.00	2509.00	281.00	119.00	1530.00	11471.00	1409.00
1962	15251.00	2403.00	3307.00	2808.00	2523.00	22490.00	.00	5336.00
1963	2371.00	.00	.00	1703.00	10335.00	.00	.00	.00
1964	1419.00	9642.00	.00	.00	14171.00	4370.00	.00	.00
1965	5509.00	4501.00	.00	3403.00	.00	35553.00	.00	5222.00
1966	10114.00	14536.00	.00	25550.00	23257.00	16405.00	768.00	5449.00
1967	8146.00	10002.00	.00	15031.00	7142.00	13010.00	.00	5135.00
1968	3076.00	1041.00	.00	2295.00	10066.00	79600.00	5032.00	5207.00
1969	54237.00	36252.00	.00	20019.00	50523.00	6006.00	24790.00	.00
1970	2109.00	.00	.00	163.00	4205.00	6333.00	.00	.00
1971	1103.00	.00	.00	.00	.00	.00	.00	.00
1972	677.00	.00	.00	.00	.00	.00	.00	.00
1973	5342.00	6895.00	8771.00	15245.00	5238.00	.00	.00	10322.00
COL SUM	121178.00	141339.00	76737.00	113457.00	254557.00	273492.00	399456.00	174937.00
CUL DECH	4039.00	4700.00	2557.00	3081.00	3813.57	9116.40	10316.00	5831.23
CUL WAFU	1.00	1.07	.63	.94	2.18	2.26	.03	1.44

SUMMARY OF ALL CANYONS WITH DEBRIS BASIN RECORDS IN YEARS 1943-44. THE LOCATION (LA = LA RIVER, SO = SAN GABRIEL) AND YEARS OF RECORD ARE ALSO NOTED. YIELDS IN CUYUS/SQ MI.

COLUMN YEARS	(9) DAY LA 1936-1	(10) LAS FLORES LA 1936-1	(11) LINCOLN LA 1936-1	(12) NICHOLS LA 1938-1	(13) PICKERS LA 1936-1	(14) SHIELDS LA 1938-1	(15) SIERRA MADRE LA 1938-1	(16) SNYDER LA 1938-1
1944	1855.00	5962.00	3732.00	772.00	4835.00	3737.00	602.00	2134.00
1945	2485.00	1013.00	490.00	522.00	817.00	802.00	706.00	4134.00
1946	00	1520.00	00	235.00	303.00	1606.00	00	00
1947	00	1060.00	3722.00	637.00	522.00	77.00	476.00	533.00
1948	00	00	00	408.00	230.00	00	00	00
1949	00	00	00	625.00	00	00	00	00
1950	00	00	00	1287.00	00	00	00	00
1951	00	00	00	2315.00	724.00	49529.00	2307.00	12513.00
1952	7455.00	4161.00	8076.00	2453.00	2354.00	25.00	25840.00	00
1953	00	00	00	00	00	00	00	00
1954	00	00	00	00	00	00	00	00
1955	00	00	00	00	00	00	00	00
1956	00	00	00	00	00	00	00	00
1957	00	00	00	00	00	00	00	00
1958	00	00	00	00	00	00	00	00
1959	00	00	00	00	00	00	00	00
1960	00	00	00	00	00	00	00	00
1961	00	00	00	00	00	00	00	00
1962	00	00	00	00	00	00	00	00
1963	00	00	00	00	00	00	00	00
1964	00	00	00	00	00	00	00	00
1965	00	00	00	00	00	00	00	00
1966	00	00	00	00	00	00	00	00
1967	00	00	00	00	00	00	00	00
1968	00	00	00	00	00	00	00	00
1969	00	00	00	00	00	00	00	00
1970	00	00	00	00	00	00	00	00
1971	00	00	00	00	00	00	00	00
1972	00	00	00	00	00	00	00	00
1973	00	00	00	00	00	00	00	00
CUL SUM	144095.00	176750.00	104304.00	7720.00	112321.00	178058.00	180476.00	100392.00
CUL MEAN	4323.17	5450.63	3479.76	2304.21	3410.70	5052.21	3562.00	3525.73
CUL RATIO	1.19	1.17	1.10	0.04	0.84	1.18	0.68	0.73

SUMMARY OF ALL CANYONS WITH DEKINS BASIN RECORDS IN YEARS 1943-44. THE LOCATION IS LA RIVER 4.50 = SAY GABRIEL AND YEARS OF RECORD ARE ALSO NOTED. YIELD IN CU YDS/SQ MI.

CUL IN YEARS	(17) STOUGH LA 1941-	(14) SUNSET UPPER LA 1933-	(19) VERMILION LA 1935-	(20) WEST RAVINE LA 1935-	(21) WILLOW LA 1943-	QOW SUMS	QOW MEANS	QOW RATIOS
1944	7892.06	2084.00	3163.03	19212.02	4347.00	129435.94	6470.761	1.53
1945	2555.03	251.00	2032.00	1234.00	1024.00	31224.00	15612.00	1.04
1946	.00	367.00	.00	2540.00	1600.00	22350.00	10170.00	1.55
1947	.00	.00	37.00	2440.00	1604.00	25393.00	12600.00	1.29
1948	.00	.00	.00	32.00	0.00	1680.00	64.00	.22
1949	.00	.00	.00	.00	379.00	1004.00	706.00	.34
1950	.00	.00	.00	.00	215.00	1503.00	710.00	.58
1951	.00	.00	.00	.00	.00	.00	.00	.00
1952	8516.00	702.00	5137.00	10940.00	7167.00	241300.00	120600.00	1.51
1953	.00	.00	7002.00	.00	.00	5140.00	2500.00	.35
1954	.00	.00	.00	4064.00	2710.00	42844.00	2102.00	.81
1955	2425.00	.00	.00	.00	64.00	2482.00	124.00	.19
1956	.00	.00	1284.00	.00	.00	20416.00	14200.00	.06
1957	.00	7010.00	274.00	.00	1540.00	21506.00	10700.00	1.02
1958	4714.00	3410.00	1002.00	5400.00	2420.00	117531.00	58910.00	1.04
1959	2437.00	4565.00	199.00	10564.00	3500.00	52658.00	2652.00	.45
1960	.00	.00	.00	.00	946.00	10748.00	902.00	.65
1961	.00	5140.00	.00	3370.00	557.00	56711.00	23650.00	1.55
1962	049.00	.00	3087.00	1408.00	3570.00	92539.00	4616.00	.33
1963	.00	.00	373.00	524.00	421.00	124700.00	62500.00	2.17
1964	.00	5203.00	.00	.00	000.00	35073.00	1748.00	1.27
1965	20703.00	6144.00	1371.00	34428.00	3030.00	153035.00	7650.00	1.43
1966	5054.00	24145.00	5000.00	8600.00	6650.00	31265.00	15000.00	1.57
1967	1212.00	2302.00	2653.00	17200.00	4217.00	117170.00	5370.00	.72
1968	.00	3005.00	1504.00	17200.00	2031.00	107031.00	5370.00	1.75
1969	1070.00	2406.00	6041.00	02000.00	4322.00	657125.00	32600.00	.95
1970	.00	3409.00	242.00	2400.00	1509.00	37000.00	18000.00	.87
1971	.00	.00	732.00	3200.00	.00	17237.00	8030.00	.74
1972	.00	.00	.00	.00	.00	6000.00	344.00	.49
1973	1900.00	4518.00	1975.00	12000.00	1450.00	125229.00	62610.00	1.17
CUL SUM	05002.00	15240.00	36340.00	19702.00	31000.00	2584765.00		
CUL MEAN	2122.73	5084.85	1211.40	6569.73	1720.83	80292.70		
CUL RATIO	.55	1.26	.30	1.03	.45	21.56		

APPENDIX 2

Section 1 - Results of Linear Regression

APPENDIX 2. Linear Regression Results with Debris Records

X=L.A.W.S. Y=Dunsmore

For the groups of years listed

LINEAR REGRESSION DATA FILES

YEAR	X=L.A.W.S.	Y=DUNSMORE
1944	4231	4628
1945	5597	5539
1946	6426	8162
1947	7413	8162
1948	7791	8162
1949	7849	8162
1951	8142	8162
1951	8927	8162
1952	15514	21287
1953	16245	21287
1954	18834	21287
1955	20359	21287
1956	22162	22696
1957	23222	26981
1958	26421	32566
1959	29513	32566
1960	30373	32566
1961	32594	35146
1962	40545	38513
1963	49424	43165
1964	51843	43165
1965	56212	43165
1966	66326	43165
1967	74472	46545
1968	77548	46259
1969	111823	66354
1970	113096	68163
1971	115159	68163
1972	115856	68163
1973	121193	76753

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 43382.7
 THE AVERAGE VALUE OF Y IS 32596.3
 THE STANDARD DEVIATION OF X IS 38943.3
 THE STANDARD DEVIATION OF Y IS 21574.8
 THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .871446

REGRESSION EQUATION

= 9462.89 + .537965 * X

14.2931 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 ? 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...

TYPE FIRST YEAR, LAST YEAR? 1944,1972

WISH DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 49346.3

THE AVERAGE VALUE OF Y IS 31873.4

THE STANDARD DEVIATION OF X IS 36672.1

THE STANDARD DEVIATION OF Y IS 28249.9

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .966123

REGRESSION EQUATION

= 9571.22 + .533473 * X

93.3365 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 P 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...
TYPE FIRST YEAR, LAST YEAR: 1944,1971
WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 37643.1
THE AVERAGE VALUE OF Y IS 29748.3
THE STANDARD DEVIATION OF X IS 34288.5
THE STANDARD DEVIATION OF Y IS 10299.6
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .961856

REGRESSION EQUATION

$$= 9387.85 + .541396 * X$$

92.5187 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 ? 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR. LAST YEAR? 1944,1974

WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 34735.0

THE AVERAGE VALUE OF Y IS 28326

THE STANDARD DEVIATION OF X IS 31321.6

THE STANDARD DEVIATION OF Y IS 18109.2

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .955871

REGRESSION EQUATION

= 9128.98 + .552657 * X

91.369 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 ? 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944,1969

WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 31637.4

THE AVERAGE VALUE OF Y IS 26793.8

THE STANDARD DEVIATION OF X IS 27554.9

THE STANDARD DEVIATION OF Y IS 16537.4

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .94663

REGRESSION EQUATION

$Y = 8733.56 + .569855 * X$

69.5243 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 ? 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944,1945

WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 28481.8

THE AVERAGE VALUE OF Y IS 25191.4

THE STANDARD DEVIATION OF X IS 22642.0

THE STANDARD DEVIATION OF Y IS 14733.1

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .93415

REGRESSION EQUATION

$$Y = 7873.84 + .607246 * X$$

37.2637 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 2 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944,1967
WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	26437.4	
THE AVERAGE VALUE OF Y IS	24313.6	
THE STANDARD DEVIATION OF X IS	28637.3	
THE STANDARD DEVIATION OF Y IS	14366.6	
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.933312

REGRESSION EQUATION

$Y = 7935.81 + .653536 * X$

8.1368 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 ? 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944, 1966
WISH DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 24348.9
THE AVERAGE VALUE OF Y IS 23398.5
THE STANDARD DEVIATION OF X IS 18325.9
THE STANDARD DEVIATION OF Y IS 13942.7
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .949589

REGRESSION EQUATION

$Y = 5799.17 + .722468 * X$

0.1719 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 ? 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944,1955

WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 22448.9

THE AVERAGE VALUE OF Y IS 22491.6

THE STANDARD DEVIATION OF X IS 16251.4

THE STANDARD DEVIATION OF Y IS 13571.7

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .965164

REGRESSION EQUATION

$Y = 4405.08 + .895955 * X$

93.1427 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 ? 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944, 1964
WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 29832.7
THE AVERAGE VALUE OF Y IS 21587.2
THE STANDARD DEVIATION OF X IS 14751.4
THE STANDARD DEVIATION OF Y IS 13877.2
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .96911

REGRESSION EQUATION

$Y = 3608.16 + .859179 * X$

93.9174 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 ? 1,2
HOW MANY YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944, 1962
IS DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 17743.4
THE AVERAGE VALUE OF Y IS 19227.4
THE STANDARD DEVIATION OF X IS 11673.0
THE STANDARD DEVIATION OF Y IS 11597.0
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .966146

REGRESSION EQUATION

$Y = 2323.75 + .952494 * X$

3.3438 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT TO RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

Y MUST BE BETWEEN 1 AND 2 P 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT.....

TYPE FIRST YEAR, LAST YEAR? 1944, 1961

ST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	16148.6	
THE AVERAGE VALUE OF Y IS	18156	
THE STANDARD DEVIATION OF X IS	9632.49	
THE STANDARD DEVIATION OF Y IS	14821.5	
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.937303

REGRESSION EQUATION

$Y = 242.754 + 1.18928 * X$

7.4945 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 ? 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944,1953
IS DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 13179.3
THE AVERAGE VALUE OF Y IS 151.02
THE STANDARD DEVIATION OF X IS 7459.87
THE STANDARD DEVIATION OF Y IS 9051.14
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .983244

REGRESSION EQUATION

$Y = -620.72 + 1.19298 * X$

6.6769 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT TO RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 P 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944,1957
WANT DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	12233.5	
THE AVERAGE VALUE OF Y IS	13354.6	
THE STANDARD DEVIATION OF X IS	6743.82	
THE STANDARD DEVIATION OF Y IS	7942.82	
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.978934

REGRESSION EQUATION

$Y = -252.415 + 1.15298 * X$

95.8311 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

WANT AGAIN WITH DATA ACCUMULATED (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 P 1,2
HOW MANY YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944,1955
DO YOU HAVE DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 11388.4
THE AVERAGE VALUE OF Y IS 12344.8
THE STANDARD DEVIATION OF X IS 6199.73
THE STANDARD DEVIATION OF Y IS 7272.94
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .972223

REGRESSION EQUATION

$$Y = -151.589 + 1.1412 * X$$

4.658 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

DO YOU WANT TO ADD MORE DATA (YES OR NO)?

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
Y MUST BE BETWEEN 1 AND 2 > 1,2
ON YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944, 1955
T DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

AVERAGE VALUE OF X IS 18494.6
AVERAGE VALUE OF Y IS 12023.9
STANDARD DEVIATION OF X IS 5522.66
STANDARD DEVIATION OF Y IS 6937.77
CORRELATION COEFFICIENT BETWEEN X AND Y IS .8761

REGRESSION EQUATION

$Y = -339.78 + 1.22521 * X$

.2771 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

AGAIN WITH DATA ACCUMULATED (YES OR NO)?

DO YOU WISH TO ACCUMULATE THE DATA (YES OR NO)? YES
DO YOU WISH TO PRINT THE MATRIX (YES OR NO)? NO
DO YOU WISH TO RUN A STATISTICAL TEST ON THE MATRIX DATA (YES OR NO)? YES
TESTS AVAILABLE: LINEAR REGRESSION(1), TTEST WITH RANDOM DATA(2),
AND TTEST WITH PAIRED DATA(3)...TYPE CODE OF DESIRED TEST (1,2 OR 3)? 1

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 ? 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...
TYPE FIRST YEAR, LAST YEAR? 1964,1973
LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	93343.8	
THE AVERAGE VALUE OF Y IS	56939.5	
THE STANDARD DEVIATION OF X IS		27803.8
THE STANDARD DEVIATION OF Y IS		13670.3
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.9697371

REGRESSION EQUATION

$Y = 13864.4 + .476791 * X$

94.8391 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X..

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

APPENDIX 3

SEDIMENT TREND STUDY UPDATE DATA TABLES

SECTION 1. Data Table of Debris Yields for L.A.W.S. , and
Dunsmore. (includes debris basin records plus
DAMCAP storage for years 1964,1966,1971,1973)

SECTION 2. Random Data t-Tests of Data Table in Section 1.
- entire record, 1944 to 1973
- years 1944 to 1964 (before check dam treatment)
- years 1964 to 1973 (after treatment years)

SECTION 3. Paired Data t-Tests of Data Table in Section 1.
- entire record 1944 to 1973
- years 1944 to 1964
- years 1964 to 1973

SECTION 4. Linear Regression of Data Table in Section 1., as
accumulated data for the years:

1944-73	Entire record to year	30
1944-72	" " " "	29
1944-71	" " " "	28
1944-70	" " " "	27
1944-69	" " " "	26
1944-68	" " " "	25
1944-67	" " " "	24
1944-66	" " " "	23
1944-65	" " " "	22
1944-64	" " " "	21

SECTION 5. DAMCAP Data Computer Printout

SECTION 1. Data Table of Debris Yields for L.A.W.S. , and
Dunsmore. (includes debris basin records plus
DAMCAP storage for years 1964,1966,1971,1973)

YEAR	(1) L.A.W.S.	(2) DUNSMORE	ROW SUMS	ROW MEANS
1944	4231	4628	4628	4628
1945	1366	911	911	911
1946	829	2623	2623	2623
1947	987	0	0	0
1948	288	0	0	0
1949	148	0	0	0
1950	151	0	0	0
1951	27	0	0	0
1952	7487	13125	13125	13125
1953	731	0	0	0
1954	2589	0	0	0
1955	1216	0	0	0
1956	2112	1409	1409	1409
1957	1458	4285	4285	4285
1958	3201	5585	5585	5585
1959	3097	0	0	0
1960	1355	0	0	0
1961	1721	2580	2580	2580
1962	13951	3367	3367	3367
1963	2879	4652	4652	4652
1964	1419	17431	17431	17431
1965	5369	0	0	0
1966	10114	17342	17342	17342
1967	8146	2380	2380	2380
1968	3076	714	714	714
1969	34280	20595	20595	20595
1970	2162	1309	1309	1309
1971	1163	26629	26629	26629
1972	697	0	0	0
1973	5342	24038	24038	24038
*****		*****		
COL SUMS	121198	153653		
COL MEANS	4039.93	5121.77		
COL RATIOS	1	1.26779		

DO YOU WISH TO RUN A STATISTICAL TEST ON THE MATRIX DATA (YES OR NO)?
TESTS AVAILABLE: LINEAR REGRESSION(1), TTEST WITH RANDOM DATA(2),
AND TTEST WITH PAIRED DATA(3)...TYPE CODE OF DESIRED TEST (1,2 OR 3)?

SECTION 2. Random Data t-Tests of Data Table in Section 1.

- entire record, 1944 to 1973
- years 1944 to 1964 (before check dam treatment)
- years 1964 to 1973 (after treatment years)

T-TEST DATA FILES

YEAR	L.A.U.S.	DUNSMORE
1944	4231	4623
1945	1366	911
1946	829	2623
1947	937	3
1948	238	0
1949	148	0
1950	151	0
1951	27	0
1952	7487	13125
1953	731	0
1954	2589	0
1955	1216	0
1956	2112	1420
1957	1358	4235
1958	3201	5585
1959	3097	0
1960	1355	0
1961	1721	2520
1962	13951	3367
1963	2879	4652
1964	1419	17431
1965	5369	0
1966	18114	17342
1967	8146	2383
1968	3076	714
1969	34280	23595
1970	2168	1382
1971	1163	26620
1972	697	3
1973	5342	24023

DATA MEANS 4839.93 5121.77

OUTPUT FOR T-TEST WITH RANDOMIZED DATA

THE VALUE OF T = .57492

FOR L.A.U.S. THE STANDARD DEVIATION = 5562.63 AND THE STANDARD ERROR OF THE MEAN = 1198.17

FOR DUNSMORE THE STANDARD DEVIATION = 7947.14 AND THE STANDARD ERROR OF THE MEAN = 1456.94

THE POOLED STANDARD DEVIATION FOR L.A.U.S. + DUNSMORE = 7217.34

IF .57492 IS GREATER THAN THE T-TABLE VALUE FOR 58 DEGREES OF FREEDOM, THE CONCLUSION IS THAT THE MEAN VALUE OF L.A.U.S. OF 4839.93 REPRESENTS A DIFFERENT POPULATION THAN DOES THE MEAN VALUE OF DUNSMORE OF 5121.77 AT THE SIGNIFICANCE LEVEL SELECTED.

RUN AGAIN WITH DATA NOT ACCUMULATED (YES OR NO)? YES

T-TEST WITH RANDOMIZED DATA

ENTER COLUMN NUMBERS OF VARIABLES TO BE COMPARED...
THEY MUST BE BETWEEN 1 AND 2 P 1.2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944, 1964

LIST DATA (YES OR NO)? NO

OUTPUT FOR T-TEST WITH RANDOMIZED DATA

THE VALUE OF T = .33227

FOR L.A.W.S. THE STANDARD DEVIATION = 3149.45 AND THE STANDARD ERROR
OF THE MEAN = 687.256

FOR DUNSMORE THE STANDARD DEVIATION = 4591.05 AND THE STANDARD ERROR
OF THE MEAN = 1031.85

THE POOLED STANDARD DEVIATION FOR L.A.W.S. + DUNSMORE = 3236.8

IF .38227 IS GREATER THAN THE T-TABLE VALUE FOR 43 DEGREES OF
FREEDOM, THE CONCLUSION IS THAT THE MEAN VALUE OF L.A.W.S. OR 2421.14
REPRESENTS A DIFFERENT POPULATION THAN DOES THE MEAN VALUE OF
DUNSMORE OR 2885.52 AT THE SIGNIFICANCE LEVEL SELECTED.

RUN AGAIN WITH DATA NOT ACCUMULATED (YES OR NO)?

YES

T-TEST WITH RANDOMIZED DATA

ENTER COLUMN NUMBERS OF VARIABLES TO BE COMPARED...
THEY MUST BE BETWEEN 1 AND 2 ? 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...
TYPE FIRST YEAR, LAST YEAR? 1940,64,1973
LIST DATA (YES OR NO)? NO

OUTPUT FOR T-TEST WITH RANDOMIZED DATA

THE VALUE OF T = .819366

FOR L.A.U.S. THE STANDARD DEVIATION = 10322.2 AND THE STANDARD ERROR
OF THE MEAN = 3169.29

FOR DUNSMORE THE STANDARD DEVIATION = 11081.5 AND THE STANDARD ERROR
OF THE MEAN = 3504.29

THE POOLED STANDARD DEVIATION FOR L.A.U.S. + DUNSMORE = 10565.1

IF .819366 IS GREATER THAN THE T-TABLE VALUE FOR 18 DEGREES OF
FREEDOM, THE CONCLUSION IS THAT THE MEAN VALUE OF L.A.U.S. OR 7177.42
REPRESENTS A DIFFERENT POPULATION THAN DOES THE MEAN VALUE OF
DUNSMORE OR 11348.8 AT THE SIGNIFICANCE LEVEL SELECTED.

RUN AGAIN WITH DATA NOT ACCUMULATED (YES OR NO)?

SECTION 3. Paired Data t-Tests of Data Table in Section 1.

- entire record 1944 to 1973
- years 1944 to 1964
- years 1964 to 1973

T-TEST WITH PAIRED DATA

ENTER COLUMN NUMBERS OF VARIABLES TO BE COMPARED...

THEY MUST BE BETWEEN 1 AND 2 2 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944, 1973

LIST DATA (YES OR NO)? NO

OUTPUT FOR T-TEST WITH PAIRED DATA

THE VALUE OF T = .769695

THE STANDARD DEVIATION OF THE PAIRED DATA = 7698.44

THE STANDARD ERROR OF THE MEAN = 1445.54

IF .769695 IS GREATER THAN THE T-TABLE VALUE FOR 29 DEGREES OF FREEDOM, THE CONCLUSION IS THAT THE MEAN VALUE OF L.A.W.S. FOR 4439.93 REPRESENTS A DIFFERENT POPULATION THAN DOES THE MEAN VALUE OF DUNSMORE OR 5121.77 AT THE SIGNIFICANCE LEVEL SELECTED.

RUN AGAIN WITH DATA NOT ACCUMULATED (YES OR NO)?

YES

T-TEST WITH PAIRED DATA

ENTER COLUMN NUMBERS OF VARIABLES TO BE COMPARED....

THEY MUST BE BETWEEN 1 AND 2 ? 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944,1964

LIST DATA (YES OR NO)? NO

OUTPUT FOR T-TEST WITH PAIRED DATA

THE VALUE OF T = .453254

THE STANDARD DEVIATION OF THE PAIRED DATA = 4695.55

THE STANDARD ERROR OF THE MEAN = 1424.65

IF .453254 IS GREATER THAN THE T-TABLE VALUE FOR 24 DEGREES OF FREEDOM, THE CONCLUSION IS THAT THE MEAN VALUE OF L.A.U.G. OR 2421.14 REPRESENTS A DIFFERENT POPULATION THAN DOES THE MEAN VALUE OF DUNSMORE OR 2835.52 AT THE SIGNIFICANCE LEVEL SELECTED.

RUN AGAIN WITH DATA NOT ACCUMULATED (YES OR NO)?

YES

T-TEST WITH PAIRED DATA

ENTER COLUMN NUMBERS OF VARIABLES TO BE COMPARED...
THEY MUST BE BETWEEN 1 AND 2 $\geq 1,2$
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...
TYPE FIRST YEAR, LAST YEAR? 1964, 1973
LIST DATA (YES OR NO)? NO

OUTPUT FOR T-TEST WITH PAIRED DATA

THE VALUE OF T = .976419

THE STANDARD DEVIATION OF THE PAIRED DATA = 12538.1

THE STANDARD ERROR OF THE MEAN = 3964.89

IF .976419 IS GREATER THAN THE T-TABLE VALUE FOR 9 DEGREES OF
FREEDOM, THE CONCLUSION IS THAT THE MEAN VALUE OF L.A.M.S. OR 7177.48
REPRESENTS A DIFFERENT POPULATION THAN DOES THE MEAN VALUE OF
DUNSMORE OR 11448.8 AT THE SIGNIFICANCE LEVEL SELECTED.

RUN AGAIN WITH DATA NOT ACCUMULATED (YES OR NO)? NO
DO YOU WISH TO RUN ANOTHER STATISTICAL TEST WITH THE DATA NOT ACCUMULATED
? NO
RUN AGAIN (YES OR NO)? NO

YES

SECTION 4. Linear Regression of Data Table as follows:

LINEAR REGRESSION DATA FILES

YEAR	X=L.A.M.S.	Y=QUINSMORE
1944	4231	4623
1945	5527	5539
1946	6626	8162
1947	7413	8162
1948	7741	8162
1949	7649	3162
1950	3488	4152
1951	8527	2162
1952	15514	21287
1953	16245	21237
1954	18334	21237
1955	25454	21237
1956	22162	22696
1957	23224	26981
1958	26421	32566
1959	29518	32556
1960	33873	32566
1961	32594	35146
1962	46545	38513
1963	49424	43165
1964	56343	64526
1965	56212	66596
1966	66326	77938
1967	74472	83518
1968	77548	81132
1969	111823	101627
1970	113996	102236
1971	115159	129565
1972	115856	129565
1973	121193	163653

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 43482.7
 THE AVERAGE VALUE OF Y IS 46218.4
 THE STANDARD DEVIATION OF X IS 38943.3
 THE STANDARD DEVIATION OF Y IS 42243.7
 THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .983325

REGRESSION EQUATION

$$Y = 341.156 + 1.36656 * X$$

98.692% PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

THE ABOVE DATA ACCUMULATED (YES OR NO)? YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 P 1.2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944,1972
LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	42386.3	
THE AVERAGE VALUE OF Y IS	42505.5	
THE STANDARD DEVIATION OF X IS		36672.1
THE STANDARD DEVIATION OF Y IS		37736.2
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.987482

REGRESSION EQUATION

$$Y = 1593.46 + 1.41573 * X$$

97.45% PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 P 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR 1944,1971

LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 37633.1

THE AVERAGE VALUE OF Y IS 39324.2

THE STANDARD DEVIATION OF X IS 34253.5

THE STANDARD DEVIATION OF Y IS 34434.6

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .986116

REGRESSION EQUATION

$Y = 2184.69 + .989454 * X$

97.2429 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 251,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...
TYPE FIRST YEAR, LAST YEAR? 1944,1973
LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 34735.9
THE AVERAGE VALUE OF Y IS 35056.6
THE STANDARD DEVIATION OF X IS 31321.6
THE STANDARD DEVIATION OF Y IS 39131.5
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .985126

REGRESSION EQUATION

$Y = 3155.57 + .747491 * X$

77.2445 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 P 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...
TYPE FIRST YEAR, LAST YEAR? 1944,1959
LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	31587.4	
THE AVERAGE VALUE OF Y IS	35434.3	
THE STANDARD DEVIATION OF X IS		27559.8
THE STANDARD DEVIATION OF Y IS		27453.4
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.9852

REGRESSION EQUATION

$Y = 2346.61 + .98222 * X$

97.4624 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 ? 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944,1968
LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	28481.8	
THE AVERAGE VALUE OF Y IS	30758.6	
THE STANDARD DEVIATION OF X IS		22642.8
THE STANDARD DEVIATION OF Y IS		24108.6
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.93659

REGRESSION EQUATION

$Y = 727.093 + 1.05441 * X$

97.3359 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY....

THEY MUST BE BETWEEN 1 AND 2 P 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR(S) LAST YEAR(S)

LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 26437.4

THE AVERAGE VALUE OF Y IS 28663.2

THE STANDARD DEVIATION OF X IS 28637.3

THE STANDARD DEVIATION OF Y IS 22243.7

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .987577

REGRESSION EQUATION

$Y = 536.287 + 1.06204 * X$

96.7463 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 P 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944,1966

LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 24348.9

THE AVERAGE VALUE OF Y IS 26412.1

THE STANDARD DEVIATION OF X IS 18325.9

THE STANDARD DEVIATION OF Y IS 19813.7

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .978234

REGRESSION EQUATION

$$Y = 694.866 + 1.45771 * X$$

95.764 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

N"YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 P 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....

TYPE FIRST YEAR, LAST YEAR? 1944,1965

LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF Y IS 22446.9

THE AVERAGE VALUE OF X IS 24676.3

THE STANDARD DEVIATION OF X IS 16251.4

THE STANDARD DEVIATION OF Y IS 16787.4

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .9748361

REGRESSION EQUATION

$Y = 1684.77 + 1.02137 \cdot X$

94.8749 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...
THEY MUST BE BETWEEN 1 AND 2 P 1,2
WHICH YEARS OF DATA DO YOU WISH TO LOOK AT....
TYPE FIRST YEAR, LAST YEAR? 1944,1966
LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS	23332.7	
THE AVERAGE VALUE OF Y IS	22337.2	
THE STANDARD DEVIATION OF X IS		14758.4
THE STANDARD DEVIATION OF Y IS		14941.3
THE CORRELATION COEFFICIENT BETWEEN X AND Y IS		.956499

REGRESSION EQUATION

$Y = 1933.32 + .979323 * X$

93.4894 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)?

YES

LINEAR REGRESSION

ENTER COLUMN NUMBERS OF X,Y VARIABLES RESPECTIVELY...

THEY MUST BE BETWEEN 1 AND 2 ? 1,2

WHICH YEARS OF DATA DO YOU WISH TO LOOK AT...

TYPE FIRST YEAR, LAST YEAR? 1964, 1973

LIST DATA (YES OR NO)? NO

REGRESSION AND CORRELATION OUTPUT

THE AVERAGE VALUE OF X IS 93343.8

THE AVERAGE VALUE OF Y IS 97782.6

THE STANDARD DEVIATION OF X IS 27893.8

THE STANDARD DEVIATION OF Y IS 31496.3

THE CORRELATION COEFFICIENT BETWEEN X AND Y IS .917871

REGRESSION EQUATION

$Y = 3845.7 + 1.43977 * X$

84.2486 PERCENT OF THE VARIATION IN Y IS ACCOUNTED FOR BY MEASURING X.

RUN AGAIN WITH DATA ACCUMULATED (YES OR NO)? NO

DO

DEBRIS DAM STORAGE DETERMINATIONS
LOS ANGELES WATERSHED

CHANNEL SYSTEM NO. DAMS ACCESS DATE
DUNSMORE CYN 9 11/8/73

***	***	***	***	***	***
DAM 10	HEIGHT	WIDTH	ANGLE	DEBRIS	CAPACITY
<u>DJ-81</u>	(FT)	(FT)	(X)	LENGTH(FT)	(CU YDS)
	16	95	12	368	6780
	CHECK	DEBRIS LENGTH	VOLUME	PERCENT	
	DATE	(FT)	(CU YDS)	FULL	
	1964	68	226.773	3.38468	
	1966	123	1814.19	27.4774	
	1972	240	4473.13	66.7526	
	1973	273	5832.18	75.8761	

***	***	***	***	***	***
DAM 11	HEIGHT	WIDTH	ANGLE	DEBRIS	CAPACITY
<u>DJ-82</u>	(FT)	(FT)	(X)	LENGTH(FT)	(CU YDS)
	16	73	12.2	350	4580
	CHECK	DEBRIS LENGTH	VOLUME	PERCENT	
	DATE	(FT)	(CU YDS)	FULL	
	1964	98	546.536	12.1453	
	1966	133	1647.11	36.6224	
	1972	223	2833.39	62.4643	
	1973	238	2961.71	65.8157	

***	***	***	***	***	***
DAM 12	HEIGHT	WIDTH	ANGLE	DEBRIS	CAPACITY
<u>DJ-83</u>	(FT)	(FT)	(X)	LENGTH(FT)	(CU YDS)
	15	55	14	338	3683
	CHECK	DEBRIS LENGTH	VOLUME	PERCENT	
	DATE	(FT)	(CU YDS)	FULL	
	1964	89	487.287	13.5762	
	1965	118	1024.49	33.4831	
	1972	223	2843.81	66.7937	
	1973	310	2818.96	93.9653	

***	***	***	***	***	***
DAM 13	HEIGHT	WIDTH	ANGLE	DEBRIS	CAPACITY
<u>DJ-84</u>	(FT)	(FT)	(X)	LENGTH(FT)	(CU YDS)
	16	98	13.5	330	6180
	CHECK	DEBRIS LENGTH	VOLUME	PERCENT	
	DATE	(FT)	(CU YDS)	FULL	
	1964	138	1329.92	21.4543	
	1966	142	2597.66	42.5748	

1972	324	5910.93	46.7824
1973	330	7480.27	122.720

DAM ID	HEIGHT (FT)	WIDTH (FT)	ANGLE (X)	DEBRIS LENGTH(FT)	CAPACITY (CU YDS)
<u>DU-35</u>	15	85	11.1	320	5348

CHECK DATE	DEBRIS LENGTH (FT)	VOLUME (CU YDS)	PERCENT FULL
1964	134	1216.50	22.8345
1965	144	2324.13	43.8515
1972	315	5134.55	96.8439
1973	328	5753.32	140.553

DAM ID	HEIGHT (FT)	WIDTH (FT)	ANGLE (X)	DEBRIS LENGTH(FT)	CAPACITY (CU YDS)
<u>DU-36</u>	18	60	15.6	340	7900

CHECK DATE	DEBRIS LENGTH (FT)	VOLUME (CU YDS)	PERCENT FULL
1964	118	2335.33	29.5612
1966	178	3406.15	55.2045
1972	230	5356.47	67.8434
1973	240	5567.9	70.7329

DAM ID	HEIGHT (FT)	WIDTH (FT)	ANGLE (X)	DEBRIS LENGTH(FT)	CAPACITY (CU YDS)
<u>DU-37</u>	26	125	14.3	560	23100

CHECK DATE	DEBRIS LENGTH (FT)	VOLUME (CU YDS)	PERCENT FULL
1964	170	6159.29	26.6636
1966	310	12625.1	55.5193
1972	440	18178.9	78.562
1973	580	20635.9	89.3328

DAM ID	HEIGHT (FT)	WIDTH (FT)	ANGLE (X)	DEBRIS LENGTH(FT)	CAPACITY (CU YDS)
<u>DU-38</u>	26	90	14.8	600	18600

CHECK DATE	DEBRIS LENGTH (FT)	VOLUME (CU YDS)	PERCENT FULL
1964	204	3435.25	53.512
1966	324	5564.80	53.5443
1972	600	11803.3	113.493
1973	630	15330.4	147.407

DAM ID	HEIGHT (FT)	WIDTH (FT)	ANGLE (X)	DEBRIS LENGTH(FT)	CAPACITY (CU YDS)
<u>DU-39</u>	18	55	18.6	390	5600

CHECK DATE	DEBRIS LENGTH (FT)	VOLUME (CU YDS)	PERCENT FULL
1964	120	1739.85	31.0545
1960	210	3029.96	54.1004
1972	390	8710.29	155.541
1973	390	14296.6	255.236

SYSTEM CAPACITY
(CU YDS)

72600

VOLUME
(CU YDS)

79900.5

PERCENT
FULL

110.850

YEAR

1964

1966

1972

1973

VOLUME MEASURED
(CU YDS)

17430.9

34773.0

64402.0

79900.5

TIME : 0601

APPENDIX 4

RESEARCH DATA

- Section 1 - Resume of Dry Creep Study
Research Note No. 171, November 1960
- Section 2 - Paper No. 12
Seasonal Debris Movement from Steep
Mountain Slopes in Southern California
- Section 3 - Emergency Measures After a Fire
(the 37% rule of thumb document)
- Section 4 - List of 91 Basins in L.A.W.S., with
back up data for each basin

RESUME OF DRY CREEP STUDY

1. THE GREATEST AMOUNT OF DRY CREEP IS ON THE SOUTH FACING UNDERCUT SLOPES.
2. 89% OF ALL PREFIRE DEBRIS CAME FROM DRY SEASON PRODUCTION.
3. 91% OF POST FIRE DEBRIS WAS DRY CREEP.
4. WET SEASON DEBRIS IS RELATED MORE TO STORM INTENSITY THAN TO TOTAL PRECIP. THIS MEANS THAT AS LONG AS THE STORM INTENSITY DOES NOT EXCEED THE CAPACITY OF THE SOIL TO ABSORB, THE WATER ACTUALLY INCREASES THE COHESION OF SOIL PARTICLES AND THERE IS A DECREASE IN SOIL MOVEMENT.
5. FIRE INCREASES THE DRY CREEP.

SITE	PRE-FIRE			POST FIRE		
	X-TON/A/YR	CU.YD/A/YR	CY/MI/Y	X-T/A/Y	CY/A/YR	CY/MI/YR
3	2.70	1.80	1,152	10.20	6.80	4,352
4	1.65	1.10	704	28.95	19.30	12,352
5	2.88	1.92	1,229	24.19	16.13	10,323
X-All	2.69	1.79	1,146	24.67	16.45	10,528

6. THIS TABLE IS THE OVERLAND DRY CREEP INTO CHANNELS, AND DOES NOT REFLECT THE AMOUNT THAT WOULD BE PRODUCED FROM A BURNED WATER-SHED AFTER A FIRE. THE POST FIRE DEBRIS PRODUCTION WILL INCLUDE:
 1. ALL CHANNEL STORAGE
 2. SIDE SLOPE STORAGE THAT UNDERCUT AND SLUFFED OFF.
 3. DRY CREEP FOR THE TIME INTERVAL BETWEEN THE FIRE AND THE FLOOD.
 4. LAND SLIPS AND SLIDES TRIGGERED BY SATURATION, ETC.
7. THE ANNUAL SEDIMENT PRODUCTION IS SOMEWHERE BETWEEN THE PRE-FIRE AND POST-FIRE RATE, DUE TO TEMPORARY SLOPE STORAGE.

* P.S.W. Research Note No. 171 , 11/60, Erosion From Mountain Side Slopes After Fire In Southern California By j.s. Krammes.

Paper No. 12 Fed. Interagency Sed. Conf. 1963 - U.S.D.A. Misc. Pub. 970, p.p. 85 - 89, 1965 Seasonal Debris Movement From Steep Mountainside Slopes In Southern California

Both papers are in work file

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

PACIFIC SOUTHWEST
FOREST AND RANGE
EXPERIMENT STATION
BERKELEY - CALIFORNIA

RESEARCH NOTE

No. 171

November 1960

EROSION FROM MOUNTAIN SIDE SLOPES AFTER FIRE IN SOUTHERN CALIFORNIA

By

Jay S. Krammes, Research Forester

The night of July 21, 1960 was a hectic one for firefighters setting backfires along the Glendora Mountain Road in a desperate effort to check the Johnstone Fire on the San Dimas Experimental Forest. What made the job so hectic? Not the fire, but dangerous, active erosion! The men had to be continually alert to dodge large rocks rolling down-slope only seconds after the fire passed.

These men were witnessing how fast and furiously erosion begins after a southern California brush fire. Less than a week after the Johnstone Fire, so much soil material had moved down the denuded slopes that debris cones often blocked roads and trails (fig. 1).

In most areas, surface runoff of rainfall is the main cause of soil erosion. In the rugged San Gabriel Mountains, however, we are faced with a two-fold erosion problem: winter scour from surface runoff plus "dry creep" from steep side slopes during the summer. ^{1/} Fire's destruction of the plant cover greatly accelerates these processes. Until recently no one had a good opportunity to measure dry creep following a fire, but the Woodwardia Fire provided the opportunity when it swept over an established erosion study area in the mountains above Los Angeles during October 1959.

^{1/} Anderson, H. W., G. B. Coleman, and P. W. Zinke. Summer slides and winter scour...dry-wet erosion in southern California mountains. U. S. Forest Serv., Pacific Southwest Forest and Range Expt. Sta., Tech. Paper 36. 12 pp., illus. July 1959.

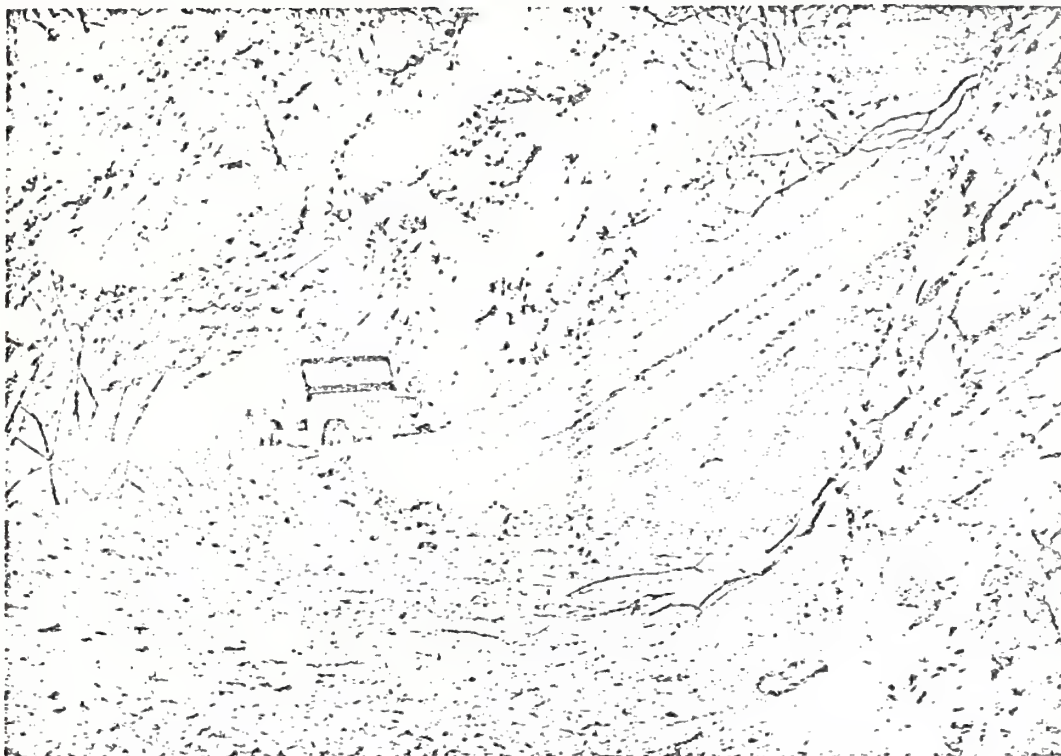


Figure 1.--Road blocked by slide one week after the Johnstone Fire on the San Dimas Experimental Forest.

Anderson, Coleman, and Zinke had found that under long unburned conditions dry-season debris movement exceeded wet-season movement on most of the study sites. ^{2/} Their report covered a 5-year period; 4 years of below normal rainfall and 1 year of above average rainfall. This report gives data for an additional 2 years, the second of which followed the Woodwardia Fire, and shows the tremendous acceleration of soil movement from a fire-denuded area.

Field Procedures

Half-round steel troughs connected to the original soil surface by a concrete apron were used to catch the debris moving downslope (fig. 2). Wooden baffles installed at two of the sites to catch bouncing rocks were destroyed by the fire. Consequently, a portion of the first measurements following the burn had to be estimated. Later measurements proved the estimates to be rather conservative. Otherwise, material caught in each trough was removed and weighed, corrected for moisture, and sampled for organic matter and rock content. Troughs along the contour of the slopes ranged in length from 10 to 431 feet.

^{2/} Anderson, Coleman, and Zinke, op. cit.



Figure 2.--Debris trough at Falls Canyon. Collector trough filled with debris from dry season movement. Foot trail below the trough has eroded away since the fire.

Results

Debris production rates for the year before the fire showed generally the same trend as published in the 1959 report. ^{3/} The steep south rejuvenated slopes ^{4/} were again the greatest producers. Precipitation during the 1958-59 season was 70 percent of normal. Only one storm caused any appreciable wet-season movement, and the rate of debris movement was about the same as previously reported.

On October 13, 1959, the Woodwardia Fire burned four erosion measurement sites in the Arroyo Seco drainage. Immediately after the fire dry creep changed to rapid dry sliding. Although debris movement varied widely, all sites showed a marked increase in dry-season movement.

The first two measurements after the fire showed that side slope erosion had increased at all sites (table 1). The steep south rejuvenated

^{3/} Anderson, Coleman, and Zinke, op. cit.

^{4/} Rejuvenated slopes are the steep slopes flanking stream channels in which renewed channel downcutting has removed the toe of the slope creating an unstable condition and active erosion is taking place.

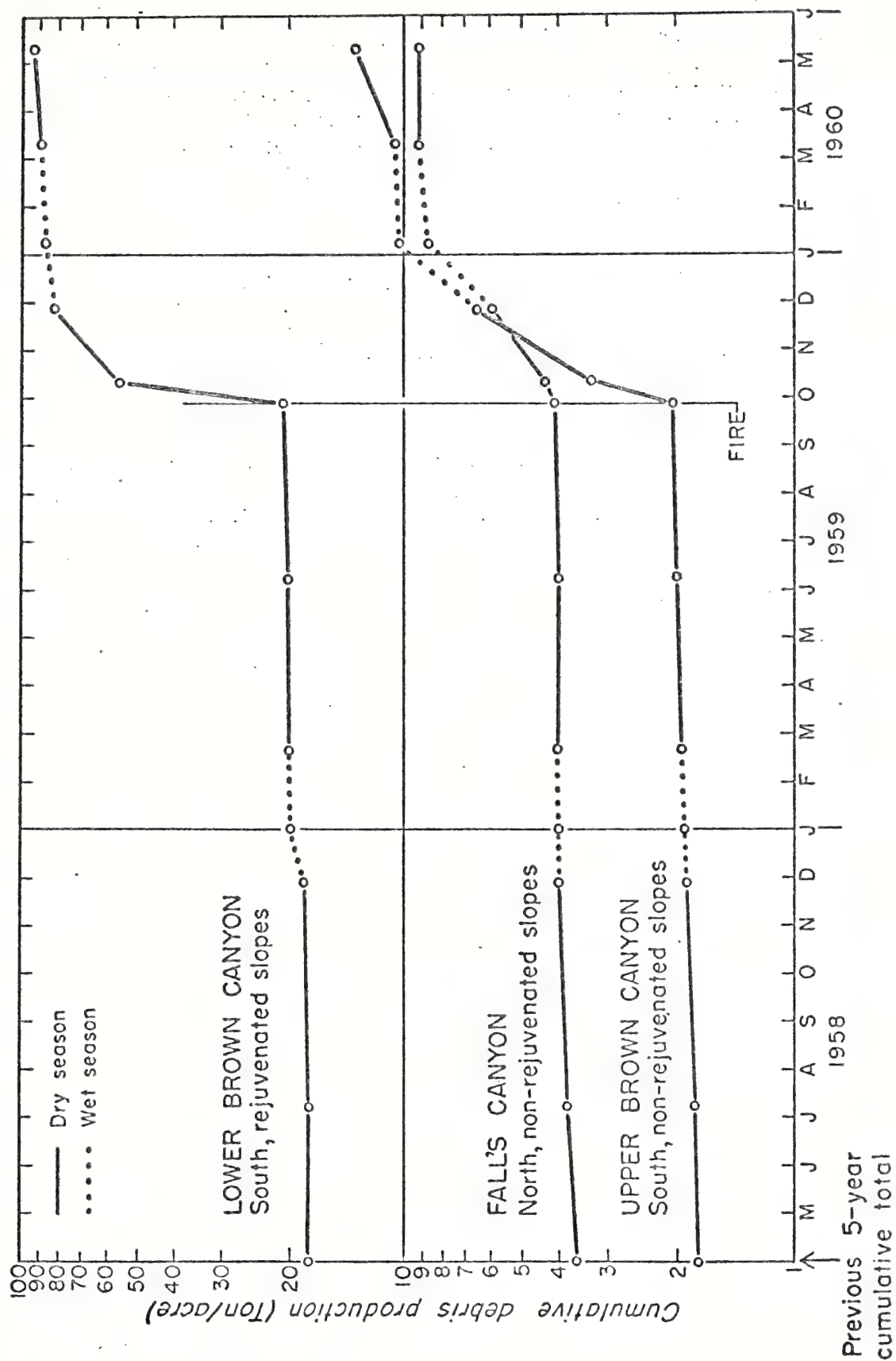
slopes were still by far the greatest producers, with a 10-fold increase over an already high pre-fire rate (fig. 3). Total annual production from the south-facing Lower Brown sites was 24.7 tons per acre, of which 21.9 tons per acre (89 percent) of the soil movement came from dry sliding during the first 88 days after the fire.

Table 1.--Seasonal debris movement, south rejuvenated slopes

Season	: Number :	: Lower Brown : Site III	: Lower Brown : Site IV	: Lower Brown : Site V	: Lower Brown : Site III, IV, V
:	: of :	: Dry :	: Wet :	: Dry :	: Wet :
From : To (inc.) :	days :	season :	season :	season :	season :
		Tons per acre	Tons per acre	Tons per acre	Tons per acre
Five years before fire		6.104	11.331	5.943	4.568
4/16/58 12/11/58	238	.479	--	.546	--
12/12/58 3/5/59	82	--	1.667	--	1.276
3/6/59 6/23/59	111	.157	--	.050	--
Total pre-fire		6.740	12.998	6.539	5.844
Tons/Acre/Season		.84	1.86	.82	.83
Tons/Acre/Year		2.70		1.65	
After fire					
6/25/59 1/8/60	167 ^{1/}	20.070	--	^{1/} 82.070	--
1/9/60 3/21/60	100	--	5.150	--	^{2/} 6.511
3/22/60 5/23/60	62	2.798	--	4.005	--
Total post-fire		22.868	5.150	86.075	6.511
Tons/Acre/Season		7.62	2.58	28.69	3.26
Tons/Acre/Year		10.20		28.95	

1/ Portion of catch estimated because of fire damage to trough installations.

2/ High rate caused by a large limb falling in the chute.



North rejuvenated slopes showed a post-burn rate of 4.3 tons per acre per year--an increase to about 17 times the unburned average (table 2). Dry-season movement amounted to 3.9 tons per acre or nearly 91 percent of total. Debris production from north non-rejuvenated sites increased 16 times (table 3). The smallest increase of only 4-fold occurred at the south non-rejuvenated site, Upper Brown, where surface rock outcrops served to stabilize the slope somewhat.

Precipitation during the 1959-60 rainy season was 59 percent of normal; consequently post-fire wet-season movement was small.

Table 2.--Seasonal debris movement, north rejuvenated slopes

Season			Number of days	Lower Brown Site I		Lower Brown Site II	
From	To (inc.)	Dry season		Wet season	Dry season	Wet season	
			<u>Tons per acre</u>		<u>Tons per acre</u>		
Five years before fire			.660	.642	.675	.544	
4/16/58	12/11/58	238	.148	--	.092	--	
2/12/58	3/5/59	82	--	.088	--	.130	
3/6/59	6/23/59	111	.030	--	.038	--	
Total pre-fire			.838	.730	.805	.674	
Tons/Acre/Season			.14	.15	.13	.13	
Tons/Acre/Year			.26		.26		
After fire							
6/25/59	1/8/60	167	12.299	--	9.926	--	
1/9/60	3/21/60	100	--	.983	--	.458	
3/22/60	5/23/60	62	.741	--	.719	--	
Total post-fire			13.040	.983	10.645	.458	
Tons/Acre/Season			4.35	.49	3.55	.23	
Tons/Acre/Year			4.84		3.78		

Summary and Conclusions

How much is dry creep erosion increased after the native plant cover is destroyed? Side slope erosion directly related to the Woodwardia Fire ranged from 2.2 to 24.7 tons per acre the first year after the fire. South slopes flanking rejuvenated stream channels yielded the most debris, 10 times the pre-burn rate. Nearly 89 percent of the eroded material came during the dry season.

Table 3.--Seasonal debris movement, nonrejuvenated slopes

			:Number:Singing Springs		Singing Springs		: Upper Brown		: Falls			
Season			: of :		South :		North :		South :		North	
From : To (inc.):			days	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	
			Tons per acre		Tons per acre		Tons per acre		Tons per acre			
Five years before fire			.518	1.003	.516	.511	2.105	1.500	1.103	.685		
4/16/58	12/11/58	138	.102	--	.066	---	.373	--	.121	--		
12/12/58	1/15/59	34	.574	--	.149	--	--	.032	--	.028		
1/16/59	3/5/59	48	--	.323	--	.196	--	.061	--	.020		
3/5/59	6/24/59	111	.017	--	.017	--	.044	--	.044	--		
Total pre-fire			1.211	1.326	.748	.707	2.522	1.593	1.268	.733		
Tons/Acre/Season			.13	.22	.08	.12	.32	.23	.16	.10		
Tons/Acre/Year			.35		.20		.55		.26			
After fire												
6/25/59	12/10/59	167	--	--	--	--	1.846	--	4.519	--		
12/11/59	3/21/60	100	--	--	--	--	--	3.067	--	4.053		
3/22/60	5/23/60	62	--	--	--	--	.085	--	1.618	--		
Total post-fire			--	--	--	--	1.931	3.067	6.137	4.053		
Tons/Acre/Season			--	--	--	--	.64	1.53	2.05	2.03		
Tons/Acre/Year			--	--	--	--	2.17		4.08			

Other study sites showed similar large increases of 4 to 17 times the pre-fire rates. Dry-season debris movement exceeded wet-season movement at all but one of the study sites. However, precipitation during the period of measurement was below normal, and the few gentle rains gave cohesion to the soil rather than winter scour.

The absence of appreciable winter scour in the first year after the burn does not necessarily decrease debris hazard. The eroded debris remains poised in the stream channels until high flows at some later date carry it destructively to the valley below (fig. 4).

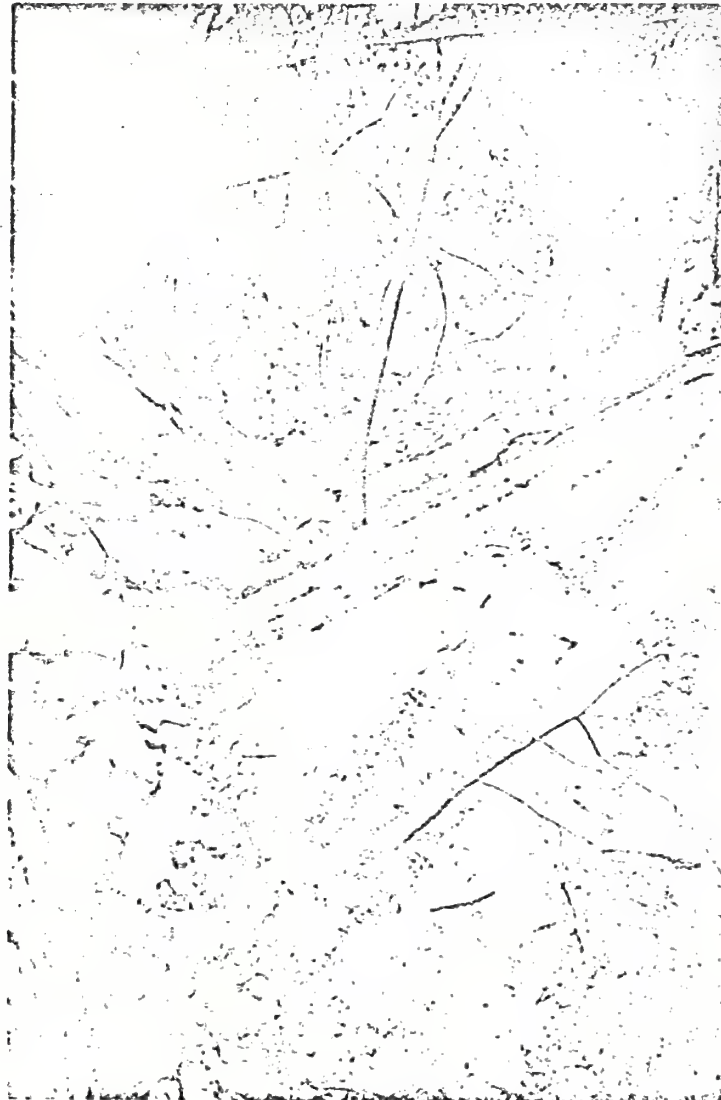


Figure 4.--Lower Brown Canyon. Eroded material perched in the channel bottom which will eventually be flushed from the channel and deposited in debris basins, reservoirs, and property in the valley below.

SEASONAL DEBRIS MOVEMENT FROM STEEP MOUNTAINSIDE SLOPES IN SOUTHERN CALIFORNIA

[Paper No. 12]

By JAY S. KRAMMES, *research forester, Pacific Southwest Forest and Range Experiment Station, Forest Service, Glendora, Calif.*

Most people become concerned about flood-borne debris only when it causes property damage or is deposited in reservoirs. Much of the debris is scoured from stream channels, where it accumulates as the product of side-slope erosion. The interest in debris movement down mountain slopes, then, stems from flood and debris control problems downstream. Though debris produced during storm runoff is often the most spectacular, dry-season debris movement is an important part of the erosion in the San Gabriel Mountains. This paper reports a comparative study of dry- and wet-season debris movement in these steep, unstable watersheds.

A study in the Los Angeles River Watershed by Retzer and others¹ showed the sources and processes of debris movement. They mapped the sources of debris and determined the important source areas, in approximate descending order, to be "(1) streambanks and slopes rejuvenated by undercutting; (2) slopes with south exposures; (3) very steep slopes; (4) fault zones and steep fault faces; and (5) deep colluvial-alluvial deposits on slopes where undercut by roads or streams."

The active agents of erosion were observed to be gravity, water, wind, and the daily freeze-thaw cycle, the latter occurring primarily at high elevations. These agents can act alone, but they commonly work together, especially water and gravity.

Erosion took place mainly as granular movement on the surface rather than as deep-seated movements of soil masses. Granular debris moved as dry creep and as slope wash. Both of these processes were active over the entire study area. About 90 percent of the area mapped was affected by dry creep movement to some degree.

Dry creep movement is not found in most regions. It requires steep slopes with dry, loose

material on the surface. The dry slide material ranges in size from larger rocks to fine soil particles. When the slopes are vegetated, some of the dry creep material is detained behind rocks, stumps, and brush. Other material not detained continues to move downslope and collect as cones in channels.

The slopes of the San Gabriel Mountains maintain a precarious equilibrium. The average slope of the land is more than 65 percent, or above the angle of repose for unconsolidated soil materials. Downslope movement may be triggered by slight disturbances: movement of animals, the wind, or earth tremors.

Surface Debris Movement Study

A study was started in 1953 to determine the cause (gravity or water), rates, and amounts of debris moving downslope and into channels.²

Study Sites

Nine study sites were located in the Los Angeles River Watershed. Five of these sites are on rejuvenated slopes.³ The other four sites are on slopes not affected by rejuvenation (table 1).

TABLE 1.—*Characteristics of debris movement study sites*

Location (name and No.)	Slope condition	Aspect	Area	Cover density	Average slope
Lower Brown —site 1.....	Rejuvenated.	NE.	Acres	Percent	Percent
Lower Brown —site 2.....		NE.	3.45	95	70
Lower Brown —site 3.....	do.....	NE.	3.36	95	70
Lower Brown —site 4.....	do.....	SE..	.72	65	90
Lower Brown —site 5.....	do.....	SE..	1.45	65	90
Lower Brown —site 6.....	do.....	SE..	.34	65	90
Upper Brown —site 7.....	Non-rejuvenated.	SW.	.68	95	55
Falls Canyon —site 8.....		NE.	1.53	95	60
Singing Springs —site 9.....	do.....	SW.	1.30	65	60
Singing Springs —site 10.....	do.....	NE.	1.64	85	55

Study sites were located on generally north- or south-facing slopes that were undisturbed by fire or road building. The experimental sites were chosen in a single rock type — the Wilson Diorite, which underlies about one-third of the San Gabriel Mountains. The soils are character-

¹ RETZER, J. L., and others. PRELIMINARY REPORT, ORIGIN AND MOVEMENT OF SEDIMENTS IN THE LOS ANGELES RIVER WATERSHED, CALIFORNIA. U.S. Forest Service. 1953. 108 pp., 1952. [Typed.]

² ANDERSON, H. W., COLEMAN, G. B., and ZINKE, P. J. SUMMER SLIDES AND WINTER SCOUR... DRY-WET EROSION IN SOUTHERN CALIFORNIA MOUNTAINS. U.S. Forest Serv. Pacific Southwest Forest and Range Expt. Sta. Tech. Paper 36, 12 pp., illus. 1953.

³ Rejuvenated slopes are the steep slopes flanking stream channels in which renewed channel downcutting has removed the toe of the slope, creating an unstable condition where active erosion is taking place.

istically shallow, coarse-textured, noncohesive, and very erodible.

Measurement of Debris

Debris moving downslope is caught in troughs that are connected to the original soil surface by a concrete apron. The troughs are built on the contour from a point of a ridge across a segment of the slope and end near a drainage channel. Troughs are placed across erosion chutes⁴ at the rejuvenated slope study sites. Catchment troughs range in length from 10 to 431 feet. Four-foot high barriers are installed at several of the sites to catch bouncing rocks and excessive debris yields.

The material caught in each trough is removed and weighed, corrected for moisture, and sampled for organic matter and rock content.

Results

Debris Production From Unburned Slopes

Anderson, Coleman, and Zinke⁵ reported the first 5 years' debris production from these sites

⁴ Erosion chutes are caused by the concentrated movement of soil and rock down segments of steep slopes during both wet and dry periods. Reference: BLACKWELDER, ELIOT. THE PROCESS OF MOUNTAIN SCULPTURE BY ROLLING DEBRIS. Jour. Geomorphology 5(4): 324-328. 1942.

⁵ See footnote 2.

⁶ KRAMMES, JAY S. EROSION FROM MOUNTAIN SIDE SLOPES AFTER FIRE IN SOUTHERN CALIFORNIA. U.S. Forest Serv. Pacific Southwest Forest and Range Expt. Sta. Res. Note 171, 8 pp., illus. 1960.

under long unburned conditions. They found that the greatest source of debris was from the south-facing rejuvenated slopes. These sites yielded an average of 3.56 tons per acre per year — 5 to 10 times the average on other sites. Debris movement during the dry season exceeded wet-season movement at most of the study sites. Even under unburned conditions, at least 0.2 ton per acre per year was measured at all study sites.

Rainfall during the first 4 years of the study was 77 percent of normal. The fifth year's precipitation was 143 percent of normal, but there were no high intensity storm periods. The first gentle rains increased the cohesion of the soil and tended to reduce wet-season debris movement.

Krammes⁶ reported a sixth year's (1958-59) debris production under unburned conditions. The south-facing rejuvenated slopes were again the greatest producers. Precipitation during the season was 70 percent of normal. One storm caused the wet-season movement to exceed dry-season movement at the south-facing rejuvenated sites and the north nonrejuvenated site 9. Six years of debris production under unburned conditions appears in tables 2, 3, and 4.

Debris Production From Burned Slopes

In October 1959 a wildfire swept through seven of the nine study sites (sites 1 through 7). Debris movement began almost immediately after the fire passed.⁷ The fire destroyed the low-growing brush that formerly detained de-

TABLE 2.—Debris production by seasons, south-facing rejuvenated slopes (Lower Brown Canyon)

Period	Site 3			Site 4			Site 5			Average sites 3, 4, and 5		
	Season			Season			Season			Season		
	Dry	Wet	Yearly	Dry	Wet	Yearly	Dry	Wet	Yearly	Dry	Wet	Yearly
Prefire (1953-59).....	0.84	1.86	2.70	0.82	0.83	1.65	1.99	0.89	2.88	1.27	1.42	2.69
Postfire:	Tons per acre			Tons per acre			Tons per acre			Tons per acre		
1st year (1959-60)...	7.62	2.58	10.20	28.69	3.26	28.95	23.38	.81	24.19	21.93	2.74	24.76
2d year (1960-61)...	1.43	34.97	36.40	5.05	21.53	26.58	1.24	10.30	11.54	3.51	23.87	27.38
3d year (1960-62)...	2.94	29.83	32.77	6.97	9.55	16.62	(1)	5.62	16.57	22.19

¹ Trough destroyed by large boulder.

² On the basis of sites 3 and 4 only.

TABLE 3.—Debris production by seasons, north-facing rejuvenated slopes, colluvial soils (Lower Brown Canyon)

Period	Site 1			Site 2			Average sites 1 and 2		
	Season			Season			Season		
	Dry	Wet	Yearly	Dry	Wet	Yearly	Dry	Wet	Yearly
Prefire (1953-59).....	0.14	0.15	0.26	0.13	0.13	0.26	0.13	0.14	0.27
Postfire:	Tons per acre			Tons per acre			Tons per acre		
1st year (1959-60).....	4.35	.49	4.84	3.55	.23	3.78	3.95	.36	4.31
2d year (1960-61).....	.23	1.40	1.63	.25	1.57	1.82	.24	1.48	1.72
3d year (1961-62).....	.45	.82	1.27	.11	1.63	1.79	.23	1.25	1.53

TABLE 4.—Debris production by season, south- and north-facing nonrejuvenated slopes (Upper Brown, Falls Canyon, and Singing Springs)

Period	Site 6 south			Site 7 north			Site 8 south ¹			Site 9 north ¹		
	Season			Season			Season			Season		
	Dry	Wet	Yearly	Dry	Wet	Yearly	Dry	Wet	Yearly	Dry	Wet	Yearly
Prefire (1953-59) ...	Tons per acre			Tons per acre			Tons per acre			Tons per acre		
Postfire:	0.32	0.23	0.55	0.16	0.10	0.26	0.13	0.22	0.35	0.08	0.12	0.20
1st year (1959-60)...	.64	1.53	2.17	2.05	2.03	4.08	.03	.02	.05	.03	.01	.04
2d year (1960-61)...	.11	4.43	4.59	.08	2.47	2.55	.04	.96	1.00	.04	.28	.32
3d year (1961-62)...	.02	2.13	2.15	.01	1.28	1.29	.03	.46	.49	.03	.18	.21

¹ Vegetation unburned.

bris on the side slopes. Great quantities of debris moved downslope and into stream channels.

First Postfire Year

Dry-season debris movement in the first year after the fire ranged from 0.6 to 21.9 tons per acre (tables 2, 3, and 4). South-facing slopes flanking rejuvenated stream channels again had the highest annual production, more than 10 times the already high prefire rate (fig. 1). Nearly 90 percent of the debris came during the dry season.

North-facing rejuvenated slopes showed a postburn rate of 4.3 tons per acre per year, or an increase of about 16 times the unburned average (table 3). Debris production from the north nonrejuvenated site increased 16 times. The smallest increase (4-fold) occurred at the south nonrejuvenated site (table 4). Rock outcrops may have served to stabilize this site somewhat.

Precipitation during the first postfire year was 59 percent of normal and no high intensity storms were recorded.

The burned area, including the study sites, was seeded with annual ryegrass (*Lolium multiflorum*) and black mustard (*Brassica nigra*) after the fire. Because of the below-normal rainfall and extended dry periods during the wet season, the seeding was not successful. On the rejuvenated sites the seed moved downslope with the debris and was buried in the stream channel.

Second Postfire Year

Rainfall in the 1960-61 year, although only 35 percent of normal, contained four storms, totaling 7.35 inches of rainfall that produced debris movement. The south-facing rejuvenated sites, which were the most unstable, produced almost 27 tons per acre (table 2).

Most of the debris was moved in the second storm of the year. The highest 5-minute intensity recorded during that storm was 1.68 inches per hour. More wet-season debris was produced during this storm from all sites than had occurred during any of the previous 8 years of measurement. Wet-season debris production ap-

pears to be related more closely to intensity than total amount of storm rainfall.

Dry-season debris production in the second postfire year was considerably less than in the first postfire dry-season.

Third Postfire Year

Precipitation during the 1961-62 year was 96 percent of normal. The first three storms of the year, with a total of 5.62 inches of rainfall, produced more than 10 tons per acre at the south-facing rejuvenated sites. Another 5 tons per acre were measured in the rest of the wet season (almost 19 inches of rainfall). Wet-season debris movement exceeded dry-season movement. Dry-season debris movement was still considerably higher than the prefire rate on the south-facing rejuvenated sites but much less than the rate during the short period just after the fire (table 2).

Discussion

Debris that is eroded from the side slopes arrives in the channels through the action of wind, water, and gravity. However, these forces do not act equally or independently. There is always a gradual downslope movement of debris in the San Gabriel Mountains. The gradual soil movement during dry seasons is the "base flow" and the wet-season movement is analogous to "storm flow." Debris movement was separated into dry-season and wet-season movements to determine variations in rate between seasons. The first light rains of the wet season quite often have little or no effect on dry movement. As soil moisture increases, cohesiveness is given to the soil and dry movement slows down. This lasts as long as soil moisture is maintained. With additional rainfall, wet movement predominates. If prolonged dry periods between storms cause a reduction in surface moisture, dry creep begins again.

Over the years, many tons of debris are deposited in stream channels during both wet and dry seasons. This material remains poised in the channels and will be moved only when winter runoff has sufficient carrying power. Such flows occur on the average of once in every 5

years. Thus, side slope erosion provides of the flood debris that is thought of as or channel scour. Stabilizing these steep

mountain slopes remains as a challenge to future erosion-control efforts in the San Gabriel Mountains of southern California.

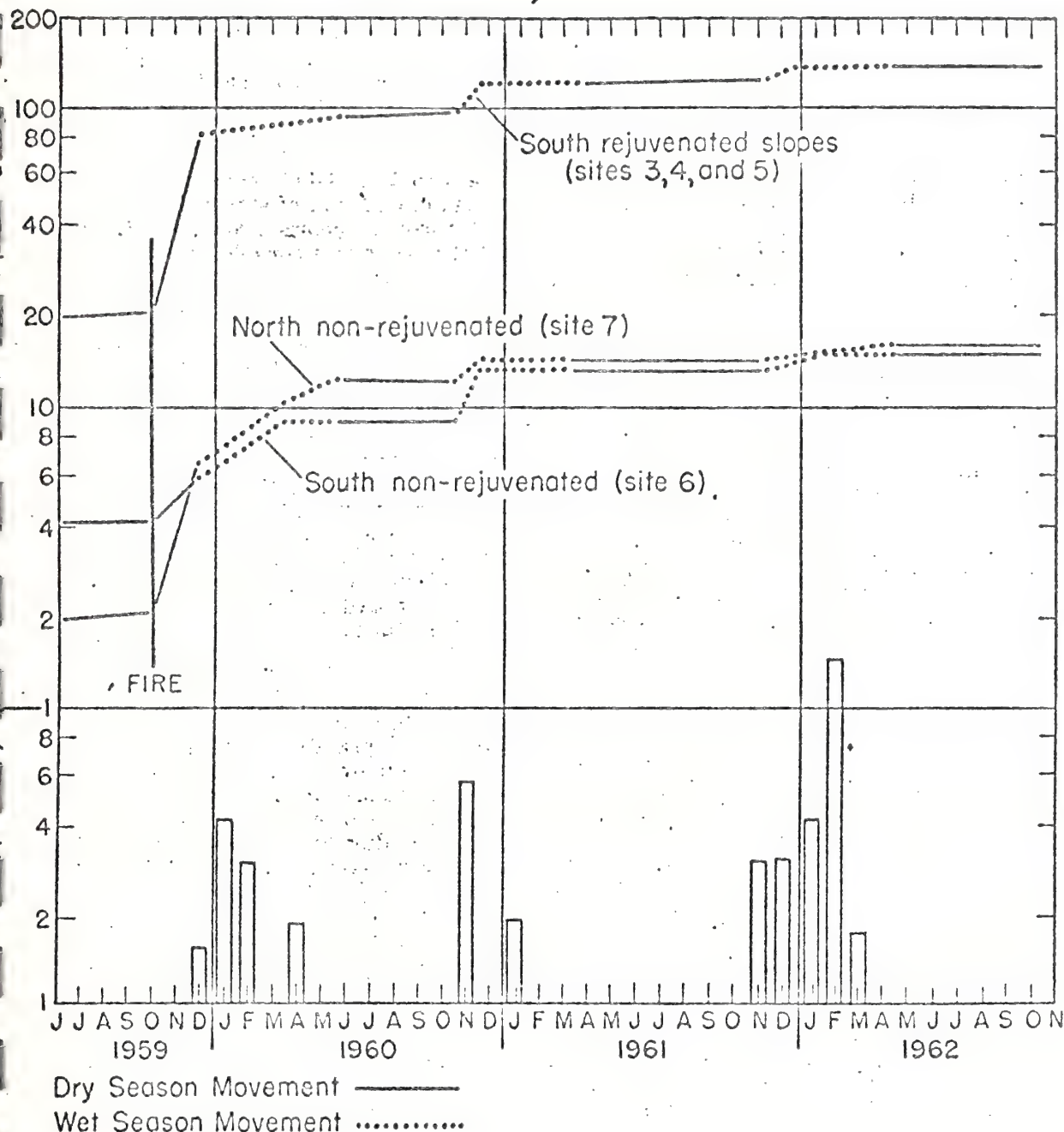


FIGURE 1.— Seasonal debris movement before and after fire in the Los Angeles watershed.

water runoff into stream channels, reduced peak discharges of streams, and effectively reduced soil erosion and resultant downstream sedimentation.

Summary

Several methods of obtaining soil stabilization on high mountain watersheds are available to the land administrator. These are (1) intensive management practices, (2) revegetation coupled with intensive management practice, and (3) contour trenching. Each method recognizes the fundamental relation existing between land cover and hydrologic behavior and reflects the importance of maintaining the productivity of the site for the production of forage, fiber, wildlife, and recreation.

The application of each method requires a careful analysis of the (1) geologic norm, (2) type of flooding, (3) watershed protection requirements, and (4) adaptability of the site for treatment.

Of the methods described, contour trenching has proved most effective in controlling flooding, and sedimentation occurring from badly deteriorated mountain watersheds. The application of this method is not a panacea for all flood-source areas but has proved effective in controlling flooding from badly deteriorated lands occasioned by high intensity summer rainstorms.

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EMERGENCY MEASURES TO CONTROL EROSION AFTER A FIRE ON THE SAN DIMAS EXPERIMENTAL FOREST

[Paper No. 19]

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Southern California is in urgent need of better solutions to its flood and erosion problems. Its steady population growth has resulted in intensive urban development on the debris cones at the mouths of mountain canyons. The Mediterranean climate, which attracts thousands of newcomers to the State, favors the growth of a highly inflammable vegetative cover (chaparral) on the mountains. It also frequently pro-

duces weather conditions that promote widespread wildfires. Such fires damage watersheds on steep mountain slopes that often lie above densely populated cities. This hazard justifies flood and erosion control measures that may not be necessary in most parts of the United States.

The U.S. Forest Service is conducting a broad research program in southern California to test several flood and erosion control measures for

use after fire on mountainside slopes and in small tributary channels. This study is in progress at the San Dimas Experimental For-

est, which has been devoted to watershed reclamation research since 1933. Owing to the difficulty of burning watersheds under controlled

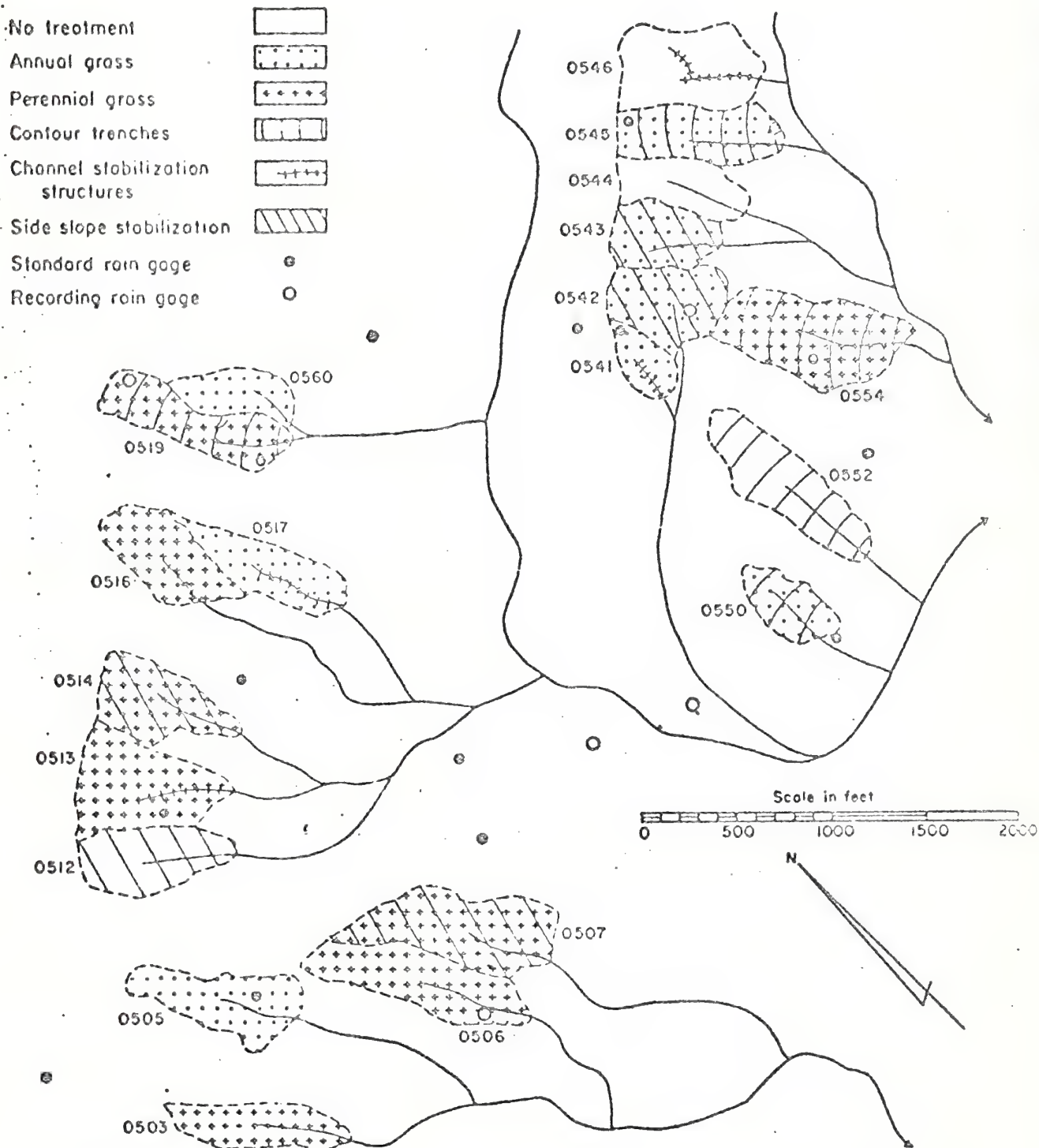


FIGURE 1.—Location of treatments on experimental watersheds testing erosion control measures.

conditions, earlier studies of erosion after fire had been limited to plots or to analyses of the effect of wildfires in the area.

In 1960 a wildfire swept most of the 17,000-acre Experimental Forest. It destroyed much valuable research underway, but it also presented an opportunity to study flood flows and erosion rates from completely burned watersheds. To exploit this opportunity, Federal, State, and county agencies undertook a cooperative emergency research program.

This paper reports on a continuing study begun during the dry winter of 1960-61, and covers data collected during the four major storms of the 1961-62 season.

Methods

We are seeking to obtain a quantitative evaluation of several mechanical and vegetative land treatments as "first aid" for burned chaparral watersheds.

Selection of Watersheds

The 20 watersheds used in this study were chosen to be as similar as possible in size (about 5 acres), shape, aspect, and erodibility (fig. 1). Even so, considerable variation existed within the group. To reduce the effect of this variability upon our study, we grouped watersheds into five erodibility classes based on three independent appraisals of their relative erodibilities.

The appraisers used slope, channel gradient, rockiness, and amount of colluvial soils as indicators of the relative erodibility of the watersheds. Treatments were then assigned to the watersheds so that apparent erodibility was balanced among treatments; that is, no treatment could be applied to all the high erodibility groups.

Instrumentation

The streamflow from each experimental watershed is measured in a 30-foot trapezoidal flume. Debris is trapped and measured behind earth-fill dams that can hold about 60 cubic yards per acre. Precipitation is measured in 5 intensity rain gages and 16 nonrecording gages distributed throughout the study area.

Selection of Treatments

In southern California broadcast sowing of annual grasses is the most widely used method of rehabilitating watersheds after a fire. Eight of the watersheds were sown to a mixture of annual grasses (Wimmera 62 ryegrass, *Lolium rigidum*; and blando brome, *Bromus mollis*)—four at the rate of 2.5 pounds per acre and four at 20 pounds per acre.

Perennial grasses—often suggested for use—were also tried. Eight watersheds were seeded to a mixture of perennial grasses (intermediate wheatgrass, *Agropyron intermedium*; pubescent wheatgrass, *A. trichophorum*; tall wheatgrass, *A. elongatum*; hardinggrass, *Phalaris tuberosa stenoptera*; big bluegrass, *Poa ampla*; smilgrass, *Oryzopsis miliacea*) and small amounts of the annuals, blando brome and Wimmera ryegrass—four at the rate of 4.5 pounds per acre and four at 20 pounds per acre. Four watersheds were left unseeded.

The areas sown to perennials were sprayed with 2,4-D and 2,4,5-T during the springs of 1961 and 1962 to help establish perennial grass by reducing competition from brush species.

Precipitation after sowing was light (total of 6.29 inches, 16 storms) during the 1960-61 season. Consequently, we had scant cover from seeded species. To correct this shortage, broadcast sowings were repeated in the fall of 1961.

In addition to the broadcast sowings, three mechanical erosion control measures were being tested. Chosen from measures currently in use in Western United States, each treatment combats the movement of water and soil at a different place along the route from raindrop impact to the debris basin. These mechanical treatments were distributed among the watersheds orthogonal to the broadcast sowings (see tables 2 and 3).

Side slope stabilization.—This treatment consisted of planting barley and fertilizer in hand-hoed rows at 2-foot intervals on the contour (150 pounds of barley and 140 pounds of diammonium phosphate per acre). Its objective was to create closely spaced barriers to the overland flow of water and debris. This treatment was compared with other mechanical measures because we were merely using plants as a means of obtaining the desired pattern of obstructions. The barley plants undoubtedly also promoted infiltration and reduced rainfall impact.

Contour trenching.—This method is being used in Idaho and Utah under somewhat different conditions of climate and soil. It has the effect of breaking up surface flow, increasing depression storage, encouraging the infiltration of storm runoff, and trapping sediment and debris. In this study the trenches were put in as close together as the terrain would permit (40 feet on the gentler slopes to 90 feet on the steeper slopes). The trenches provided storage for about 3 inches of rainfall. Storms of large size or of very high intensity may overtop the trenches. In order to provide for this situation, each trench was drained either into the stream

channel or into another trench below. This drainage system consisted of about six 12-inch half-round downspouts for each treated watershed.

Channel stabilization.—Channel stabilization was attempted by building small gravity channel check dams from soil cement. In the watersheds so treated, a system embodying both natural and artificial controls was designed to stabilize the channel in those portions with less than 30 percent normal gradient. This treatment attempts to lessen channel downcutting and, thereby, helps stabilize the toe of colluvial soils resting on side slopes.

The Analysis

A multiple linear regression model was used in analyzing the data. Nine separate analyses were made—each based on the flood peaks or debris production of an individual storm, except one analysis that used total annual debris production as a dependent variable. Several continuous variables were included in analyses in addition to the class variables used to express treatment effects. The vegetation variable expressed differences in natural vegetative recovery of the watersheds. The other continuous variables gave a further description of the inherent differences of the watersheds. The model tested was:

$$Y = a + \sum_{i=1}^4 b_i M_i + \sum_{j=1}^5 b_j V_j + b_{10} N + b_{11} R + b_{12} S + b_{13} C + b_{14} A$$

in which Y is the dependent variable expressed as cubic feet per second per acre for flood peaks or cubic yards per acre for debris production.

a is the mean response of the experimental watersheds.

M_i are the four mechanical treatment variables taking a value of 0 or 1, depending on the presence or absence of the individual treatments.

V_j are the five vegetative treatment variables treated in the same manner as the M_i .

N is the vegetative cover of the watersheds due to the residual native vegetation and the recovery of native plants (includes burned brush stems and litter). The cover was obtained

by using visual estimates of cover on clusters of four 1-square-foot quadrats distributed in a stratified (on aspect) random fashion in the watersheds. About 140 square feet of each watershed was sampled. Expressed as a percent, the native plant cover at the time of the first two storms ranged from 3.7 to 16.5 percent, with a mean value of 7.1 percent. Estimated native cover for the third and fourth storms ranged from 2.3 to 29.9 percent, with a mean of 18.2 percent. This variable was included to allow for differences in natural vegetative recovery of the watersheds.

R is the percent of the soil surface covered by rocks greater than one-half inch in diameter. This variable ranged in value from 0.4 to 15.3. The mean was 7.4 percent. This variable was intended to index the effect that armoring the surface of the watershed with rocks might have on erodibility and storm runoff.

S is the mean slope of the watershed as determined by averaging the slopes at the vegetative sampling plots. This variable ranged from 37 to 69 percent with an average of 54 percent.

C is the mean channel gradient of the watersheds measured from 1:4000 scale aerial photographs. Gradients vary from 17 to 44 percent with an average of 27 percent.

A is the area of the watershed above the flume for flood peak analyses and the area above the debris dam for debris production analyses. The average area above the flumes is 4.67 acres (range: 1.38 to 7.31 acres). The average area above the debris dam is 5.63 acres (range: 2.26 to 9.57). As Anderson reiterated in a recent paper "most of the variables which we neglect to put in our analyses and many of our mistakes in choice of functions hide in the area variable." We included area in our analyses as index-of-ignorance variable. In each of the regression analyses four models were tested for each set of dependent variables: The first analysis included all independent variables; the second omitted the continuous variable; the third omitted the vegetative treatment variable; and the fourth omitted the mechanical treatment variables.

¹ ANDERSON, H. W. A MODEL FOR EVALUATING WILDLAND MANAGEMENT FOR FLOOD PREVENTION. Pacific Southwest Forest and Range Expt. Sta. Tech. Paper 69, 12 pp. 1962.

Results¹

Storms

Four of the 22 storms during the 1961-62 season were long and intense enough to produce responses in the experimental watersheds that could be analyzed (table 1). Analysis of the

TABLE 1.—Rainfall intensities and amounts for major storms of hydrologic year 1962¹

Storm date	Maximum rainfall intensity for duration of—						Total storm precipitation
	5 min.	10 min.	15 min.	20 min.	30 min.	60 min.	
Nov. 20, 1961.	2.16	1.70	1.38	1.21	1.16	.99	2.47
Nov. 30 to Dec. 3, 1961	1.80	1.32	1.09	.96	.91	.73	4.58
Jan. 20 to Jan. 23, 1962	1.38	1.10	.92	.82	.79	.70	4.75
Feb. 7 to Feb. 12, 1962	1.59	1.24	.96	.81	.63	.39	9.27

¹Average of gages in vicinity of study watersheds.

catch of rain gages indicated there were no appreciable differences in the amounts or intensities of rainfall among the watersheds. Consequently, rainfall variables were not included in the regression analyses. The average concentration time of the watersheds is about 8 minutes. The 10-minute intensities shown in table 1 have recurrence intervals of 2.1 years, 1.1 years, 0.5 year, and 0.8 year. The recurrence intervals for the maximum 24-hour precipitation are 0.5 year, 0.6 year, and 1.0 year.

Storm of November 20, 1961

The first storm of the season had rainfall of high intensities. This downpour resulted in high flood peaks and heavy debris from the watersheds with no mechanical treatment and in moderately high peaks and moderate amounts of debris from watersheds modified by channel, check dams, or treated side slopes. The responses were small from the contour-trenched watersheds, because the storm failed to exceed the storage capacity of the trenches. During this storm, the channel-stabilizing dams continued to be filled with debris. Thus, additional channel storage was available that, consequently, reduced the flood crests of these watersheds.

¹ The authors wish to acknowledge the assistance of Donald W. Seegrist, statistician, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif., for conducting the regression analyses and statistical tests.

² Detailed data on flood peaks and debris production for each storm are available from the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, 110 North Wabash Avenue, Glendora, Calif.

Storm of November 30 to December 3, 1961

During the second storm of the season, most of the channel structures filled with debris to the level of the spillway. This storm was the first since the study was begun to exceed the storage capacity of contour trenches. Several contour trenches failed, causing an increase in flood peaks and debris production from these watersheds, although rainfall was less intense during this storm (table 1).

Storm of January 20 to 23, 1962

The third storm was the gentlest and failed to reveal any dramatic effects of treatment differences. The general relations between mechanical treatments appear to be continuing.

Storm of February 7 to 12, 1962

The last storm of the season lasted 5 days and provided about two to four times as much precipitation as any other storm (table 1). During most of the storm, the rain fell at relatively low intensities (0.25 in./hr.). The peak flows were in response to short bursts of high-intensity rainfall on the fourth day of the storm.

Additional contour trenches failed during this storm, because storage capacity was greatly exceeded. With rare exceptions check dams that stabilized channels were filled with debris. In many cases, debris cones extend upstream to the toe of the next higher dam, indicating that the design profile had been reached.

The channel-stabilized watersheds had the highest flood peaks, continuing what appears to be a trend toward higher relative crests in comparison with the other treatments. The watersheds with stabilized side slopes, on the other hand, seem to be maintaining lower relative peaks. In this storm their average was about two-thirds the average of all the other watersheds.²

Seasonal Results

Two measures of practical importance to the land manager are the total annual production of debris (the debris to be disposed of, table 2) and the highest flood peak for the year (the peak to be guarded against, table 3).

As the row means in tables 2 and 3 show, watersheds seeded to low density perennial grasses had higher peaks and heavier debris production. Debris production appears to have been reduced by the high density sowings. But whether this is a true effect is questionable, because the vegetative cover from seeded grasses in all watersheds was very low. The best cover was obtained in the watersheds having high density ryegrass where the seeded annual grass cover amounted to 1.8 percent in the spring of

TABLE 2.—Total debris production by treatments during hydrologic year 1962

Broadcast sowing treatments	Mechanical treatments				
	No mechanical treatment	Contour trenches	Channel stabilization	Side slope stabilization	Mean ¹ response
	Cu. yd./acre	Cu. yd./acre	Cu. yd./acre	Cu. yd./acre	Cu. yd./acre
No broadcast seeding	29.0	16.7	13.8	9.9	17.4
Low density annual grass	39.7	1.8	25.4	5.8	18.2
High density annual grass	31.4	6.7	8.4	9.1	13.9
Low density perennial grass	35.6	26.6	26.4	8.6	24.3
High density perennial grass	26.0	6.9	23.3	8.7	16.2
Mean response ²	32.3	11.7	19.5	8.4	18.0

¹ Row effects significant at the 0.23 level.² Column effects significant at the 0.03 level.

TABLE 3.—Highest flood peaks by treatments observed during hydrologic year 1962

Broadcast sowing treatments	Mechanical treatments				
	No mechanical treatment	Contour trenches	Channel stabilization	Side slope stabilization	Mean ¹ response
	Cu. ft./sec./acre	Cu. ft./sec./acre	Cu. ft./sec./acre	Cu. ft./sec./acre	Cu. ft./sec./acre
No broadcast seeding	2.1	1.7	1.2	3.8	2.2
Low density annual grass	6.0	1.6	2.8	1.1	2.9
High density annual grass	2.5	1.4	3.3	1.8	2.2
Low density perennial grass	3.6	7.4	7.7	2.5	5.3
High density perennial grass	3.9	0.7	3.0	1.8	2.4
Mean response ²	3.6	2.6	3.6	2.2	3.0

¹ Row effects significant at the 0.23 level.² Column effects significant at the 0.61 level.

1961 and 9.9 percent in the spring of 1962. Average total vegetative cover, exclusive of barley, on all watersheds amounted to 7.7 percent and 17.3 percent for the same periods, the majority of it being native species. In watersheds with the side-slope treatment, barley accounted for another 7.0 percent of cover in the spring of 1961 and 13.9 percent in the spring of 1962.

The mechanical treatments produced more striking contrasts, particularly in debris production. Debris yield from the watersheds with no mechanical treatment averaged about 30 cubic yards per acre when allowance is made for the effect of the continuous variables (table 4). The side-slope-stabilized watersheds yielded about 25 percent of this amount, the contour-trenched watersheds 40 percent, and the channel-stabilized watersheds 65 percent. The highest peaks (table 3) form two groupings according to mechanical treatment: (1) those from watersheds with side-slope control (contour trenches and furrow planting of barley), and (2) those from watersheds without control (channel stabilization and no mechanical treatment). This grouping held during each of the four storms studied.

The regression equations calculated from each of these two analyses are shown in table 4.

The debris regression accounted for 90 percent of the variability in the data (i.e., $R^2=0.90$) and the other regression accounted for 74 percent of the variability in peak flow. Figures 2

TABLE 4.—Regression equations for predicting total annual debris production and highest annual flood peak

Total debris regression coefficients	Peak flow regression coefficients	Independent variables
Cu. yd./acre	Cu. ft./acre	
$Y = +7.48$	$Y = -2.31$	Constant.
+11.99	+0.57	If no physical treatment.
-5.96	-0.45	If contour trenched.
+1.40	+0.78	If channel stabilized.
-7.42	-0.99	If side slope stabilized.
-1.75	-0.82	If no broadcast sowing.
+1.51	+0.10	If sown to low density annual grasses.
-4.27	-0.60	If sown to high density annual grasses.
+7.03	+2.16	If sown to low density perennial grasses.
-2.53	-0.83	If sown to high density perennial grasses.
+0.04x	-0.08x	Native vegetative cover.
+0.78x	+0.10x	Exposed rock.
+0.35x	+0.07x	Slope.
-0.37x	+0.09x	Channel gradient.
-0.73x	-0.18x	Area.

and 3 illustrate the precision of our prediction equations.

Discussion and Conclusions

The perennial grass seeding appears to be unsuited to our soils and climate. The poor establishment of perennial grass (never more than 1.7 percent cover in this experiment) could not offset the reduction in native cover, owing to herbicidal chemicals needed to assist that establishment. Watersheds seeded by low

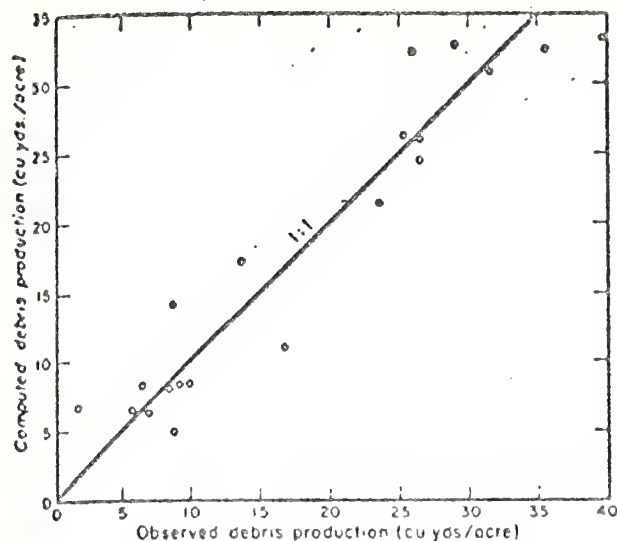


FIGURE 2.—Actual vs. predicted annual debris production (1962).

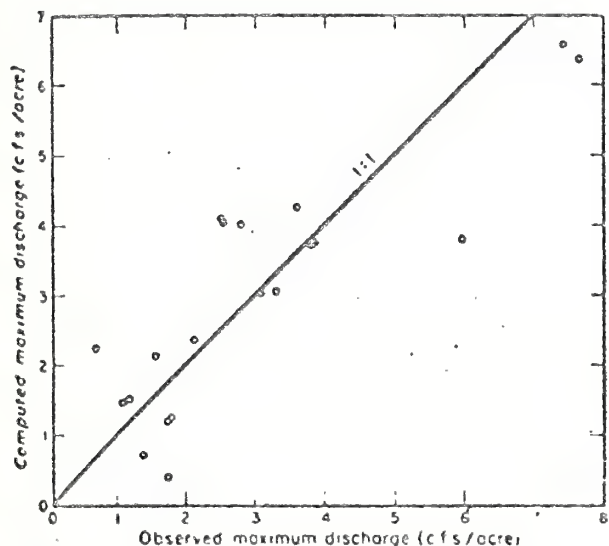


FIGURE 3.—Actual vs. predicted highest annual flood peak.

density perennials tended to have higher flood peaks and greater debris yields than the other watersheds.

Annual grass seeding, on the other hand, may be justified as an emergency erosion control measure. It had no apparent effect on flood peaks, but may have helped reduce debris. Due to the low cost of this treatment (about 1/100 the cost of the mechanical treatments) and the ease and speed with which it can be applied, land managers appear to be justified in gambling on the success of the grass crop.

But there are difficulties in relying solely on broadcast seeding for erosion control in arid regions. To grow a grass crop, an area must have enough rainfall, properly distributed. Storms must be of several days' duration for initial establishment of grass and spaced every few weeks for continued growth. Dry autumn winds, common to this area, can disperse the seed, causing a patchy catch. Also, the grass rarely provides enough cover to do much good during the first year.

We found that the first year's seeding was almost a complete failure. We reseeded the watersheds in the fall of 1961 and had a respectable response by the third and fourth storms. By July 1962, the watersheds of high density annual grass had an average cover of 10.3 percent. The seed produced by this grass promises greater effectiveness from the treatment during the coming season than past performance.

Contour trenches do not appear suited to the terrain and climate of the test watersheds, although the rather limited data do not clearly reflect this fact. By the end of the 1962 season all watersheds had several broken trenches, with little likelihood that the eroding breaks could heal before they produce large amounts of debris. The trenches were necessarily under-designed because of the steepness of the watersheds. That is, they were not spaced closely enough to provide sufficient storage for the runoff from larger storms. The test results should not be interpreted to mean that contour trenches would be ineffective if they had adequate storage. Our experience during the November 20 storm indicates that closely spaced trenches can be eminently successful in controlling erosion and in reducing peak discharge.

While trenching may not be a dependable control method under our conditions, an increase in depression storage on the side slopes would be highly effective if a method were used that was not so subject to failure. For this reason the trenches in three watersheds were repaired and strengthened so that the effects of increasing side-slope storage could be studied further in future seasons.

The reduction in debris obtained in the channel-stabilized watersheds is greater than the amount currently used to compute cost/benefit ratios for projects with this erosion control measure. However, the associated higher flood peaks argue for a closer look at this erosion control measure.

In our small watersheds, the increase in peaks may come from reduced channel roughness and shorter channel lengths caused by debris filling the rough crooked channels between the check dams. This effect would probably not be so pronounced in larger watersheds. In our case, how-

ever, the storage of debris behind the stabilizing dams during this season was probably a much larger fraction of the total debris produced than in large watersheds. These ambiguities point to a need for further study of this treatment, particularly in larger watersheds.

Side-slope stabilizing by contour furrow planting appear to be the most effective erosion control measure. But the expected effective life of this treatment is only about 4 years. Also, side-slope stabilization is difficult to establish on rapidly eroding areas, such as dry erosion chutes or steep faces undergoing rapid weathering. However, in the majority of cases these

⁴ ROWE, P. B., COUNTRYMAN, C. M., and STOREY, H. C. HYDROLOGIC ANALYSIS USED TO DETERMINE EFFECTS OF FIRE ON PEAK DISCHARGE AND EROSION RATES IN SOUTHERN CALIFORNIA WATERSHEDS. U.S. Forest Service Pacific Southwest Forest and Range Expt. Sta., 49 pp., illus. 1954.

limitations may not be serious. Usually most of the area in any watershed can be treated. Using the estimates of Rowe, Countryman, and Storey of debris after fire, with a recurrence of fire in 30 years, we find that 67 percent of a watershed's erosion takes place during the 4 years that the treatment for side-slope stabilization usually persists under conditions in southern California.

The relative superiority of the side-slope-stabilized and contour-trenched watersheds over the channel-stabilized watersheds supports the thesis that, immediately after a fire at least, erosion control measures that prevent the concentration of water or debris are most effective. Barley planted to help stabilize side slopes also provides considerable protection against rain-drop impact. From these tests we conclude that preventing the initiation of erosion is the key to postfire erosion control.

VEGETATIVE CONTROL OF STREAMBANK EROSION

[Paper No. 20]

By DONALD A. PARSONS, hydraulic engineer, USDA Sedimentation Laboratory, Soil and Water Conservation Research Division, Agricultural Research Service¹

Vegetation may protect a streambank in at least three ways. Perhaps the most important of these is the reduction of water speeds and tractive forces at the soil surface to a value below that required to cause erosion. Second in importance is, perhaps, the protection given to the bank material as a buffer against ice, logs, and other transported materials. The stalwart barrier of trees standing along the edge of a stream prevents the impact of the transported materials with the soft material of the bank. Or, in another way, the tough but pliant shrub-type materials, bending with the forces involved, act as skid surfaces for the transported materials as they are deflected by the banks of streams of all sizes.

Third, close-growing vegetation will contribute to bank stability, within a narrow range of conditions, by inducing deposition. Subsequent to a rare flood that has caused damage but not complete destruction to the vegetative cover, the deposition that occurs in minor floods helps to maintain the bank.

Since the ability of the flood flows to erode the boundary is related to the water speeds near the boundary, it is instructive to measure velocity variations in a vegetated waterway. W. O. Ree (6) did this for 8-inch long, dormant bermudagrass. His diagram is reproduced in figure 1, along with the velocity distribution in a comparable, uniform bare channel. The vegetation

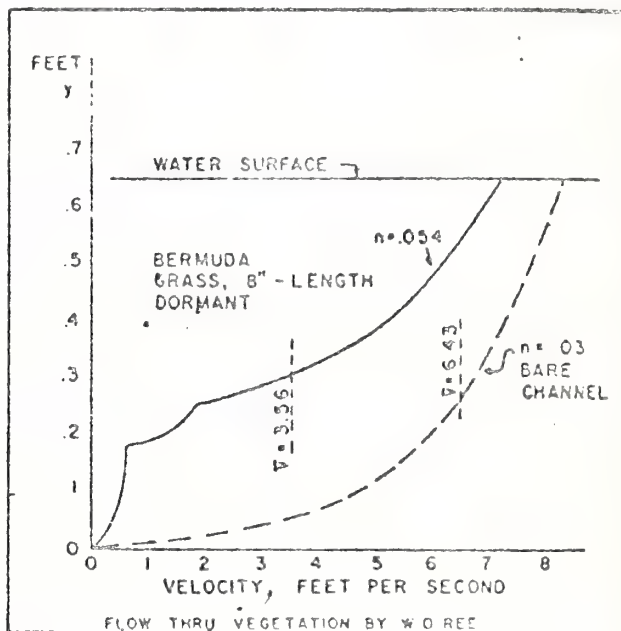


FIGURE 1.—Flow through vegetation (after W. O. Ree).

markedly reduces the water speeds near the soil surface. The rate of change of velocity with distance from the boundary also is less near the boundary with vegetation than without, indicating that the fluid shear stress at the boundary is therefore lower.

These low rates of change of velocity near the ground surface and the higher rates of change

¹ Research in cooperation with the University of Mississippi and Mississippi State University.

SUMMARY OF ALL CANYONS WITH DERRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 50-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN	(1) YEARS	(2) ALISO LA 1971-	(3) ALLEN RES. LA 1969-69	(4) ALTADENA LA 1947-	(5) ARBOR DELL LA 1972-	(6) AUBURN LA 1956-	(7) RAILEY LA 1945-	(8) BEATTY SG 1971-
1935	3425.00	.00	.00	.00	.00	.00	.00	.00
1936	5629.00	.00	.00	.00	.00	.00	.00	.00
1937	5657.00	.00	.00	.00	.00	.00	.00	.00
1938	33374.00	.00	.00	.00	.00	.00	.00	.00
1939	1976.00	.00	.00	.00	.00	.00	.00	.00
1940	2323.00	.00	.00	.00	.00	.00	.00	.00
1941	11127.00	.00	.00	.00	.00	.00	.00	.00
1942	4233.00	.00	.00	.00	.00	.00	.00	.00
1943	11277.00	.00	.00	.00	.00	.00	.00	.00
1944	4231.00	.00	.00	.00	.00	.00	.00	.00
1945	1366.00	.00	.00	.00	.00	.00	.00	.00
1946	829.00	.00	.00	.00	.00	.00	.00	.00
1947	937.00	.00	.00	.00	.00	.00	.00	.00
1948	288.00	.00	.00	.00	.00	.00	.00	.00
1949	148.00	.00	.00	.00	.00	.00	.00	.00
1950	151.00	.00	.00	.00	.00	.00	.00	.00
1951	27.00	.00	.00	.00	.00	.00	.00	.00
1952	7497.00	.00	.00	.00	.00	.00	.00	.00
1953	731.00	.00	.00	.00	.00	.00	.00	.00
1954	2539.00	.00	.00	.00	.00	.00	.00	.00
1955	1216.00	.00	.00	.00	.00	.00	.00	.00
1956	2112.00	.00	.00	.00	.00	.00	.00	.00
1957	1058.00	.00	.00	.00	.00	.00	.00	.00
1958	3231.00	.00	.00	.00	.00	.00	.00	.00
1959	3047.00	.00	.00	.00	.00	.00	.00	.00
1960	1355.00	.00	.00	.00	.00	.00	.00	.00
1961	1721.00	.00	.00	.00	.00	.00	.00	.00
1962	13251.00	.00	.00	.00	.00	.00	.00	.00
1963	2479.00	.00	.00	.00	.00	.00	.00	.00
1964	1419.00	.00	.00	.00	.00	.00	.00	.00
1965	5360.00	.00	.00	.00	.00	.00	.00	.00
1966	1411.00	.00	.00	.00	.00	.00	.00	.00
1967	8146.00	.00	.00	.00	.00	.00	.00	.00
1968	3276.00	.00	.00	.00	.00	.00	.00	.00
1969	3423.00	.00	.00	.00	.00	.00	.00	.00
1970	2168.00	.00	.00	.00	.00	.00	.00	.00
1971	1163.00	.00	.00	.00	.00	.00	.00	.00
1972	607.00	.00	.00	.00	.00	.00	.00	.00
1973	5342.00	.00	.00	.00	.00	.00	.00	.00
COL SUM	198039.00	5336.00	12222.00	62949.00	.00	255931.00	183335.00	6666.00
COL MEAN	5141.00	136.05	313.38	1614.08	.00	6562.33	4793.00	178.92
COL RATIO	1.20	.03	.06	.32	.00	1.29	.02	.03

SUMMARY OF ALL CANYONS WITH DERRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(17) CARRIAGE HSE LA 1971-	(18) CAPTER LA 1956-	(19) CHILDS LA 1965-	(20) CLOUD LA 1973-	(21) COOKS LA 1953-	(22) DEER LA 1956-	(23) DUNSMORE LA 1935-	(24) EAGLE LA 1937-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	.00	.00	.00	.00	.00	1121.00	.00
1937	.00	.00	.00	.00	.00	.00	.00	.00
1938	.00	.00	.00	.00	.00	.00	93114.00	69344.00
1939	.00	.00	.00	.00	.00	.00	.00	9731.00
1940	.00	.00	.00	.00	.00	.00	26276.00	.00
1941	.00	.00	.00	.00	.00	.00	14103.00	22606.00
1942	.00	.00	.00	.00	.00	.00	400.00	.00
1943	.00	.00	.00	.00	.00	.00	16675.00	25973.00
1944	.00	.00	.00	.00	.00	.00	4628.00	7418.00
1945	.00	.00	.00	.00	.00	.00	911.00	1789.00
1946	.00	.00	.00	.00	.00	.00	2623.00	401.00
1947	.00	.00	.00	.00	.00	.00	.00	650.00
1948	.00	.00	.00	.00	.00	.00	.00	116.00
1949	.00	.00	.00	.00	.00	.00	.00	.00
1950	.00	.00	.00	.00	.00	.00	.00	.00
1951	.00	.00	.00	.00	.00	.00	.00	.00
1952	.00	.00	.00	.00	.00	.00	13125.00	4444.00
1953	.00	.00	.00	.00	.00	.00	.00	4996.00
1954	.00	.00	.00	.00	.00	.00	.00	.00
1955	.00	.00	.00	.00	.00	.00	.00	.00
1956	.00	.00	.00	.00	.00	.00	.00	.00
1957	.00	.00	.00	.00	.00	.00	1400.00	.00
1958	.00	.00	.00	.00	.00	.00	4285.00	819.00
1959	.00	.00	.00	.00	.00	.00	5585.00	2367.00
1960	.00	.00	.00	.00	.00	.00	.00	2150.00
1961	.00	.00	.00	.00	.00	.00	2590.00	.00
1962	.00	.00	.00	.00	.00	.00	3367.00	591.00
1963	.00	.00	.00	.00	.00	.00	4652.00	2838.00
1964	.00	.00	.00	.00	.00	.00	.00	1063.00
1965	.00	.00	.00	.00	.00	.00	.00	.00
1966	.00	.00	.00	.00	.00	.00	3483.00	3483.00
1967	.00	.00	.00	.00	.00	.00	2380.00	2585.00
1968	.00	.00	.00	.00	.00	.00	714.00	15901.00
1969	.00	.00	.00	.00	.00	.00	20595.00	2205.00
1970	.00	.00	.00	.00	.00	.00	1330.00	20010.00
1971	.00	.00	.00	.00	.00	.00	.00	163.00
1972	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	.00	.00	.00	.00	.00	8571.00	15245.00
COL SU4	6660.00	16675.00	73139.00	.00	61246.00	199315.00	228423.00	240002.00
COL MEAN	170.92	4275.13	2002.79	.00	1570.41	5123.46	5857.00	6156.34
COL RATIO	.03	.84	.39	.03	.31	1.00	1.15	1.21

SUMMARY OF ALL CANYONS WITH DEBRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(25) ELMWOOD LA 1965-	(26) EMERALD EAST SG 1965-	(27) ENGLEWILD SG 1963-	(28) FAIROAKS LA 1936-	(29) FERN LA 1936-	(30) FLORAL LOWER LA 1955-59	(31) FLORAL UPPER LA 1955-62	(32) GOLF CLUB LA 1971-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	.00	.00	74814.00	.00	.00	.00	.00
1937	.00	.00	.00	69576.00	71520.00	.00	.00	.00
1938	.00	.00	.00	60185.00	70526.00	.00	.00	.00
1939	.00	.00	.00	.00	.00	.00	.00	.00
1940	.00	.00	.00	.00	.00	.00	.00	.00
1941	.00	.00	.00	19000.00	.00	.00	.00	.00
1942	.00	.00	.00	.00	.00	.00	.00	.00
1943	.00	.00	.00	13304.00	.00	.00	.00	.00
1944	.00	.00	.00	2495.00	.00	.00	.00	.00
1945	.00	.00	.00	2752.00	45300.00	.00	.00	.00
1946	.00	.00	.00	4576.00	4920.00	.00	.00	.00
1947	.00	.00	.00	3147.00	4440.00	.00	.00	.00
1948	.00	.00	.00	28.00	723.00	.00	.00	.00
1949	.00	.00	.00	.00	.00	.00	.00	.00
1950	.00	.00	.00	.00	.00	.00	.00	.00
1951	.00	.00	.00	.00	.00	.00	.00	.00
1952	.00	.00	.00	14704.00	17900.00	.00	.00	.00
1953	.00	.00	.00	.00	1533.00	.00	.00	.00
1954	.00	.00	.00	.00	.00	.00	.00	.00
1955	.00	.00	.00	.00	.00	.00	.00	.00
1956	.00	.00	.00	4961.00	1333.00	.00	.00	.00
1957	.00	.00	.00	.00	.00	.00	.00	.00
1958	.00	.00	.00	50971.00	3703.00	.00	.00	.00
1959	.00	.00	.00	13200.00	666.00	.00	.00	.00
1960	.00	.00	.00	9057.00	.00	.00	.00	.00
1961	.00	.00	.00	119.00	.00	.00	.00	.00
1962	.00	.00	.00	2523.00	1330.00	.00	.00	.00
1963	.00	.00	.00	19333.00	22440.00	.00	.00	.00
1964	.00	.00	.00	14171.00	.00	.00	.00	.00
1965	18783.00	.00	.00	.00	4376.00	.00	.00	.00
1966	18200.00	.00	3945.00	28257.00	35553.00	.00	.00	.00
1967	10322.00	.00	2751.00	7142.00	16000.00	.00	.00	.00
1968	967.00	.00	.00	16666.00	18031.00	.00	.00	.00
1969	19032.00	.00	15050.00	59523.00	70666.00	.00	.00	.00
1970	.00	.00	13750.00	4285.00	6566.00	.00	.00	.00
1971	.00	.00	.00	.00	6333.00	.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	2500.00	.00	5238.00	.00	.00	.00	.00
COL SUM	67013.00	20300.00	173607.00	501436.00	472079.00	.00	37532.00	8437.00
COL MEAN	1741.36	512.82	4451.46	12857.33	12125.00	.00	962.36	216.33
COL RATIO	.34	.10	.87	2.52	2.38	.00	.10	.04

***** 8437.00 *****

SUMMARY OF ALL CANYONS WITH DEBRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(33) GOOSEBERRY LA 1968-64	(34) GOULD LA 1949-	(35) HAINES LA 1937-	(36) HALLS LA 1936-	(37) HARRON SG 1968-	(38) HAVEN WAY LA 1972-	(39) HAY LA 1937-	(40) HILLCREST LA 1964-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	.00	.00	22008.00	.00	.00	.00	.00
1937	.00	.00	.00	26680.00	.00	.00	.00	.00
1938	.00	.00	33663.00	102004.00	.00	.00	104900.00	.00
1939	.00	.00	.00	.00	.00	.00	19155.00	.00
1940	.00	.00	7467.00	.00	.00	.00	920.00	.00
1941	.00	.00	8205.00	45953.00	.00	.00	3075.00	.00
1942	.00	.00	.00	.00	.00	.00	.00	.00
1943	.00	.00	19377.00	45597.00	.00	.00	15270.00	.00
1944	.00	.00	4182.00	7793.00	.00	.00	1055.00	.00
1945	.00	.00	.00	4789.00	.00	.00	2485.00	.00
1946	.00	.00	391.00	1618.00	.00	.00	.00	.00
1947	.00	.00	602.00	4206.00	.00	.00	.00	.00
1948	.00	.00	.00	.00	.00	.00	.00	.00
1949	.00	.00	.00	.00	.00	.00	.00	.00
1950	.00	.00	.00	.00	.00	.00	.00	.00
1951	.00	.00	.00	.00	.00	.00	.00	.00
1952	.00	.00	4028.00	20647.00	.00	.00	7435.00	.00
1953	.00	.00	2366.00	3122.00	.00	.00	.00	.00
1954	.00	.00	.00	.00	.00	.00	.00	.00
1955	.00	.00	.00	3792.00	.00	.00	.00	.00
1956	.00	.00	.00	.00	.00	.00	.00	.00
1957	.00	.00	775.00	11473.00	.00	.00	.00	.00
1958	.00	.00	36.00	1483.00	.00	.00	.00	.00
1959	.00	.00	.00	.00	.00	.00	.00	.00
1960	.00	.00	.00	.00	.00	.00	.00	.00
1961	.00	.00	.00	3904.00	.00	.00	7850.00	.00
1962	.00	.00	1147.00	14069.00	2011.00	.00	30180.00	.00
1963	.00	.00	.00	5836.00	.00	.00	23040.00	.00
1964	.00	.00	.00	.00	.00	.00	7620.00	.00
1965	.00	.00	759.00	5222.00	.00	.00	.00	.00
1966	.00	.00	5032.00	6509.00	.00	.00	.00	.00
1967	.00	.00	20718.00	5188.00	930.00	.00	11030.00	.00
1968	.00	.00	.00	52075.00	.00	.00	15000.00	.00
1969	.00	.00	.00	.00	147411.00	.00	11500.00	.00
1970	.00	.00	.00	.00	5531.00	.00	28500.00	.00
1971	.00	.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	.00	6886.00	.00	.00	.00	.00
1973	.00	.00	.00	16320.00	4186.00	.00	7500.00	.00
COL SUM	6469.00	200846.00	108657.00	417179.00	160119.00	.00	270105.00	99928.00
COL MEAN	165.87	5149.90	2786.08	10696.00	4105.62	.00	7156.54	2562.26
COL RATIO	.03	1.01	.55	2.10	.80	.00	1.40	.50

SUMMARY OF ALL CANYONS WITH DEBRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SD MI.

COLUMN YEARS	(41) HOG LA 1970-	(42) HOOK EAST SG 1969-	(43) HOOK WEST SG 1971-	(44) KINNELOA LA 1965	(45) KINNELOA LA 1966-	(46) LANNAN LA 1955-	(47) LAS FLORES LA 1936-	(48) LA TIJNA LA 1956-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	.00	.00	.00	.00	.00	23626.00	.00
1937	.00	.00	.00	.00	.00	.00	123222.34	.00
1938	.00	.00	.00	.00	.00	.00	2471.30	.00
1939	.00	.00	.00	.00	.00	.00	.00	.00
1940	.00	.00	.00	.00	.00	.00	.00	.00
1941	.00	.00	.00	.00	.00	.00	.00	.00
1942	.00	.00	.00	.00	.00	.00	.00	.00
1943	.00	.00	.00	.00	.00	.00	28355.00	.00
1944	.00	.00	.00	.00	.00	.00	5082.00	.00
1945	.00	.00	.00	.00	.00	.00	1513.00	.00
1946	.00	.00	.00	.00	.00	.00	1526.00	.00
1947	.00	.00	.00	.00	.00	.00	1066.00	.00
1948	.00	.00	.00	.00	.00	.00	.00	.00
1949	.00	.00	.00	.00	.00	.00	.00	.00
1950	.00	.00	.00	.00	.00	.00	.00	.00
1951	.00	.00	.00	.00	.00	.00	4151.00	.00
1952	.00	.00	.00	.00	.00	.00	.00	.00
1953	.00	.00	.00	.00	.00	.00	.00	.00
1954	.00	.00	.00	.00	.00	.00	.00	.00
1955	.00	.00	.00	.00	.00	.00	.00	.00
1956	.00	.00	.00	.00	.00	.00	.00	.00
1957	.00	.00	.00	.00	.00	.00	.00	.00
1958	.00	.00	.00	.00	.00	.00	.00	.00
1959	.00	.00	.00	.00	.00	.00	3200.00	.00
1960	.00	.00	.00	.00	.00	.00	.00	.00
1961	.00	.00	.00	.00	.00	.00	371.00	.00
1962	.00	.00	.00	.00	.00	.00	1166.00	.00
1963	.00	.00	.00	.00	.00	.00	54971.00	.00
1964	.00	.00	.00	.00	.00	.00	5465.00	.00
1965	.00	.00	.00	.00	.00	.00	.00	.00
1966	.00	.00	.00	.00	.00	.00	38460.00	.00
1967	.00	.00	.00	.00	.00	.00	2888.00	.00
1968	.00	.00	.00	.00	.00	.00	8222.00	.00
1969	.00	.00	.00	.00	.00	.00	44222.00	.00
1970	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	.00	.00	.00	.00	.00	5555.00	.00
COL SUM	.00	228822.00	.00	190725.00	252500.00	274560.00	356407.00	33369.00
COL MEAN	.00	5868.92	.00	4390.36	6474.56	7040.21	9140.95	855.62
COL RATIO	.00	1.15	.00	.96	1.27	1.38	1.70	.17

SUMMARY OF ALL CANYONS WITH DERRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SO MI.

COLUMN YEARS	(49) LIMEKILN LA 1965-	(50) LINCOLN LA 1936-	(51) LIL DALTON SG 1960-	(52) MADDOCK SG 1956-	(53) MAY #1 LA 1954-	(54) MAY #2 LA 1954-	(55) MCCLURE LA 1955-71	(56) MORGAN SG 1965-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	15916.00	.00	.00	.00	.00	.00	.00
1937	.00	40418.00	.00	.00	.00	.00	.00	.00
1938	.00	20122.00	.00	.00	.00	.00	.00	.00
1939	.00	.00	.00	.00	.00	.00	.00	.00
1940	.00	2376.00	.00	.00	.00	.00	.00	.00
1941	.00	23528.00	.00	.00	.00	.00	.00	.00
1942	.00	.00	.00	.00	.00	.00	.00	.00
1943	.00	20898.00	.00	.00	.00	.00	.00	.00
1944	.00	3732.00	.00	.00	.00	.00	.00	.00
1945	.00	406.00	.00	.00	.00	.00	.00	.00
1946	.00	.00	.00	.00	.00	.00	.00	.00
1947	.00	3222.00	.00	.00	.00	.00	.00	.00
1948	.00	.00	.00	.00	.00	.00	.00	.00
1949	.00	.00	.00	.00	.00	.00	.00	.00
1950	.00	.00	.00	.00	.00	.00	.00	.00
1951	.00	.00	.00	.00	.00	.00	.00	.00
1952	.00	8696.00	.00	.00	.00	.00	.00	.00
1953	.00	.00	.00	.00	.00	.00	.00	.00
1954	.00	.00	.00	.00	.00	.00	.00	.00
1955	.00	.00	.00	.00	.00	.00	.00	.00
1956	.00	.00	.00	.00	.00	.00	.00	.00
1957	.00	4520.00	.00	.00	.00	.00	.00	.00
1958	.00	3272.00	.00	.00	.00	.00	.00	.00
1959	.00	544.00	.00	.00	.00	.00	.00	.00
1960	.00	.00	.00	.00	.00	.00	.00	.00
1961	.00	.00	.00	.00	.00	.00	.00	.00
1962	.00	2002.00	.00	.00	.00	.00	.00	.00
1963	.00	1594.00	.00	.00	.00	.00	.00	.00
1964	.00	.00	.00	.00	.00	.00	.00	.00
1965	.00	1103.00	.00	.00	.00	.00	.00	.00
1966	.00	11467.00	.00	.00	.00	.00	.00	.00
1967	.00	6437.00	.00	.00	.00	.00	.00	.00
1968	.00	4200.00	.00	.00	.00	.00	.00	.00
1969	.00	9001.00	.00	.00	.00	.00	.00	.00
1970	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	6263.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	821.00	.00	.00	.00	.00	.00	.00
COL SUM	4734.00	227642.00	223828.00	125124.00	229045.00	177074.00	102130.00	21909.00
COL MEAN	1227.79	5836.97	5740.72	3208.31	5872.95	4540.36	2618.72	564.08
COL RATIO	.24	1.14	1.13	.63	1.15	.89	.51	.11

SUMMARY OF ALL CANYONS WITH DESKIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(57) NICHOLS LA 1933-	(58) PARADISE LA 1945-65	(59) PICKENS LA 1936-	(60) ROULEY LA 1955-	(61) RUBIO LA 1945-	(62) RUBY LOWER LA 1956-	(63) RUBY UPPER LA 1954-62	(64) SANTA ANITA LA 1960-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	.00	16777.00	.00	.00	.00	.00	.00
1937	.00	.00	19543.00	.00	.00	.00	.00	.00
1938	.00	.00	66411.00	.00	.00	.00	.00	.00
1939	.00	.00	4763.00	.00	.00	.00	.00	.00
1940	.00	.00	7372.00	.00	.00	.00	.00	.00
1941	.00	.00	18715.00	.00	.00	.00	.00	.00
1942	25643.00	.00	29122.00	.00	.00	.00	.00	.00
1943	3187.00	.00	4835.00	.00	.00	.00	.00	.00
1944	770.00	.00	817.00	.00	.00	.00	.00	.00
1945	322.00	1743.00	363.00	.00	3452.00	.00	.00	.00
1946	235.00	1359.00	595.00	.00	542.00	.00	.00	.00
1947	6307.00	1472.00	236.00	.00	.00	.00	.00	.00
1948	468.00	227.00	.00	.00	.00	.00	.00	.00
1949	625.00	132.00	.00	.00	.00	.00	.00	.00
1950	1287.00	.00	.00	.00	.00	.00	.00	.00
1951	.00	.00	7247.00	.00	4074.00	.00	.00	.00
1952	23158.00	14987.00	.00	.00	.00	.00	38228.00	.00
1953	.00	.00	2354.00	.00	.00	.00	.00	.00
1954	2933.00	.00	.00	1806.00	.00	.00	.00	.00
1955	.00	1781.00	.00	.00	.00	.00	.00	.00
1956	477.00	5725.00	2446.00	.00	.00	.00	.00	.00
1957	1680.00	2342.00	1375.00	1551.00	.00	2928.00	10052.00	.00
1958	1340.00	4785.00	2753.00	2584.00	.00	2642.00	1004.00	.00
1959	1585.00	325.00	497.00	.00	2231.00	535.00	.00	.00
1960	521.00	580.00	574.00	.00	402.00	.00	.00	8847.00
1961	.00	.00	4445.00	574.00	.00	92.00	.00	.00
1962	5762.00	5374.00	5627.00	1968.00	457.00	5807.00	6976.00	77647.00
1963	1452.00	1687.00	3441.00	.00	3978.00	1267.00	.00	18501.00
1964	.00	.00	425.00	.00	.00	.00	.00	1422.00
1965	963.00	.00	24219.00	6691.00	.00	.00	.00	16850.00
1966	9674.00	.00	3695.00	7241.00	17646.00	.00	.00	19162.00
1967	3723.00	.00	271.00	517.00	9643.00	2142.00	.00	42058.00
1968	3518.00	.00	26384.00	19482.00	.00	1971.00	.00	3823.00
1969	6482.00	.00	4402.00	3793.00	43650.00	20642.00	.00	77598.00
1970	3191.00	.00	.00	.00	714.00	2142.00	.00	18411.00
1971	.00	.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	5439.00	.00	15396.00	5000.00	.00	25705.00
1973	2553.00	.00	.00	.00	.00	.00	.00	19029.00
COL SUM	106653.00	43066.00	250024.00	46207.00	102145.00	53268.00	56260.00	329014.00
COL MEAN	2734.00	1104.26	6564.72	1134.79	2619.19	1365.85	1442.56	8435.26
COL RATIO	.54	.22	1.02	.23	.51	.27	.28	1.65

SUMMARY OF ALL CANYONS WITH DERRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(65) SAUPIT LA 1956-	(66) SCHOLL LA 1946-	(67) SCHOOLHOUSE LA 1963-	(68) SHIELDS LA 1938-	(69) SIERRA MADRE LA 1935-	(70) S MADRE VIL. LA 1959-	(71) SNOVER LA 1938-	(72) SOMPRERO LA 1978-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	.00	.00	.00	.00	.00	.00	.00
1937	.00	.00	.00	.00	.00	.00	.00	.00
1938	.00	.00	.00	130174.00	26427.00	.00	72560.00	.00
1939	.00	.00	.00	16259.00	.00	.00	91700.00	.00
1940	.00	.00	.00	34977.00	.00	.00	14400.00	.00
1941	.00	.00	.00	20148.00	.00	.00	26921.00	.00
1942	.00	.00	.00	3737.00	602.00	.00	2134.00	.00
1943	.00	.00	.00	1606.00	474.00	.00	530.00	.00
1944	.00	.00	.00	77.00	.00	.00	.00	.00
1945	.00	.00	.00	77.00	.00	.00	.00	.00
1946	.00	.00	.00	77.00	.00	.00	.00	.00
1947	.00	.00	.00	77.00	.00	.00	.00	.00
1948	.00	.00	.00	77.00	.00	.00	.00	.00
1949	.00	.00	.00	77.00	.00	.00	.00	.00
1950	.00	.00	.00	77.00	.00	.00	.00	.00
1951	.00	.00	.00	77.00	.00	.00	.00	.00
1952	.00	.00	.00	49529.00	2307.00	.00	12313.00	.00
1953	.00	.00	.00	25.00	23346.00	.00	.00	.00
1954	.00	.00	.00	1851.00	10863.00	.00	.00	.00
1955	.00	.00	.00	703.00	1424.00	.00	4782.00	.00
1956	.00	.00	.00	2066.00	126.00	.00	9456.00	.00
1957	.00	.00	.00	20096.00	.00	.00	3047.00	.00
1958	.00	.00	.00	.00	.00	.00	.00	.00
1959	.00	.00	.00	.00	.00	.00	.00	.00
1960	.00	.00	.00	.00	.00	.00	.00	.00
1961	.00	.00	.00	.00	.00	.00	.00	.00
1962	.00	.00	.00	.00	.00	.00	.00	.00
1963	.00	.00	.00	.00	.00	.00	.00	.00
1964	.00	.00	.00	.00	.00	.00	.00	.00
1965	.00	.00	.00	.00	.00	.00	.00	.00
1966	.00	.00	.00	.00	.00	.00	.00	.00
1967	.00	.00	.00	.00	.00	.00	.00	.00
1968	.00	.00	.00	.00	.00	.00	.00	.00
1969	.00	.00	.00	.00	.00	.00	.00	.00
1970	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	.00	.00	.00	.00	.00	.00	.00
COL SUM	21539.00	25721.00	114444.00	380426.00	136160.00	269034.00	314283.00	283.00
COL MEAN	5534.33	659.51	29344.46	9754.51	3491.28	6898.31	8058.54	7.26
COL RATIO	1.00	.13	.53	1.91	.68	1.35	1.53	.03

SUMMARY OF ALL CANYONS WITH DERRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (FG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(73) SPARR LA 1948-64	(74) SPINKS SG 1968-	(75) STETSON LA 1970-	(76) STOUGH LA 1941-	(77) STURTEVANT LA 1969-	(78) SULLIVAN LA 1971-	(79) SUNNYSIDE LA 1971-	(80) SUNSET LOWER LA 1965-
1935	.00	.00	.00	.00	.00	.00	.00	.00
1936	.00	.00	.00	.00	.00	.00	.00	.00
1937	.00	.00	.00	.00	.00	.00	.00	.00
1938	.00	.00	.00	.00	.00	.00	.00	.00
1939	.00	.00	.00	.00	.00	.00	.00	.00
1940	.00	.00	.00	.00	.00	.00	.00	.00
1941	.00	.00	.00	.00	.00	.00	.00	.00
1942	.00	.00	.00	.00	.00	.00	.00	.00
1943	.00	.00	.00	.00	.00	.00	.00	.00
1944	.00	.00	.00	.00	.00	.00	.00	.00
1945	.00	.00	.00	.00	.00	.00	.00	.00
1946	.00	.00	.00	.00	.00	.00	.00	.00
1947	.00	.00	.00	.00	.00	.00	.00	.00
1948	.00	.00	.00	.00	.00	.00	.00	.00
1949	.00	.00	.00	.00	.00	.00	.00	.00
1950	.00	.00	.00	.00	.00	.00	.00	.00
1951	.00	.00	.00	.00	.00	.00	.00	.00
1952	.00	.00	.00	.00	.00	.00	.00	.00
1953	.00	.00	.00	.00	.00	.00	.00	.00
1954	.00	.00	.00	.00	.00	.00	.00	.00
1955	.00	.00	.00	.00	.00	.00	.00	.00
1956	.00	.00	.00	.00	.00	.00	.00	.00
1957	.00	.00	.00	.00	.00	.00	.00	.00
1958	.00	.00	.00	.00	.00	.00	.00	.00
1959	.00	.00	.00	.00	.00	.00	.00	.00
1960	.00	.00	.00	.00	.00	.00	.00	.00
1961	.00	.00	.00	.00	.00	.00	.00	.00
1962	.00	.00	.00	.00	.00	.00	.00	.00
1963	.00	.00	.00	.00	.00	.00	.00	.00
1964	.00	.00	.00	.00	.00	.00	.00	.00
1965	.00	.00	.00	.00	.00	.00	.00	.00
1966	.00	.00	.00	.00	.00	.00	.00	.00
1967	.00	.00	.00	.00	.00	.00	.00	.00
1968	.00	.00	.00	.00	.00	.00	.00	.00
1969	.00	.00	.00	.00	.00	.00	.00	.00
1970	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	.00	.00	.00	.00	.00	.00	.00
COL SUM	16630.00	92780.00	4137.00	81607.00	13333.00	4873.00	5000.00	103708.00
COL MEAN	426.41	2373.07	106.00	2092.49	341.87	124.05	128.21	2661.49
COL RATIO	.00	.47	.02	.41	.07	.02	.03	.52

SUMMARY OF ALL CANYONS WITH DEBRIS BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(81) SUNSET UPPER LA 1935-	(82) TURNBULL LA 1953-	(83) VERDUGO LA 1936-	(84) WARD LOWER LA 1945-62	(85) WARD LA 1957-	(86) WEST RAVINE LA 1935-	(88) WILBUR LA 1943-1	(89) WILDWOOD SG 1968-
1935	.00	.00	.00	.00	.00	4838.00	.00	.00
1936	.00	.00	.00	.00	.00	28804.00	.00	.00
1937	.00	.00	.00	.00	.00	73264.00	.00	.00
1938	.00	.00	10483.00	.00	.00	119464.00	.00	.00
1939	.00	.00	.00	.00	.00	9612.00	.00	.00
1940	.00	.00	.00	.00	.00	2016.00	.00	.00
1941	.00	.00	8564.00	.00	.00	34464.00	.00	.00
1942	28086.00	.00	6763.00	.00	.00	716.00	.00	.00
1943	.00	.00	7798.00	.00	.00	39536.00	5113.00	.00
1944	2654.00	.00	3168.00	.00	.00	19212.00	4347.00	.00
1945	281.00	.00	2032.00	521.00	.00	1284.00	1024.00	.00
1946	327.00	.00	.00	1626.00	.00	2548.00	1606.00	.00
1947	.00	.00	39.00	4803.00	.00	2444.00	1464.00	.00
1948	.00	.00	.00	1217.00	.00	32.00	806.00	.00
1949	.00	.00	.00	643.00	.00	.00	379.00	.00
1950	.00	.00	.00	2012.00	.00	.00	216.00	.00
1951	.00	.00	.00	.00	.00	.00	.00	.00
1952	7727.00	.00	5137.00	23833.00	.00	17940.00	7147.00	.00
1953	.00	.00	1052.00	3568.00	.00	.00	.00	.00
1954	.00	.00	.00	3649.00	.00	4044.00	2716.00	.00
1955	.00	.00	.00	.00	.00	.00	64.00	.00
1956	.00	.00	1284.00	3133.00	.00	.00	.00	.00
1957	1918.00	.00	274.00	1503.00	50543.00	.00	1347.00	.00
1958	3415.00	.00	1002.00	2289.00	51360.00	5408.00	2426.00	.00
1959	4565.00	.00	199.00	2231.00	28210.00	1864.00	35.00	.00
1960	.00	.00	.00	.00	.00	.00	946.00	.00
1961	3104.00	.00	3307.00	.00	1850.00	3376.00	587.00	.00
1962	.00	.00	2947.00	.00	9973.00	1933.00	3579.00	.00
1963	.00	.00	435.00	.00	4970.00	524.00	451.00	.00
1964	5293.00	.00	.00	.00	.00	.00	666.00	.00
1965	61447.00	.00	1371.00	.00	.00	.00	863.00	.00
1966	20145.00	.00	3602.00	.00	6810.00	30428.00	6654.00	.00
1967	2514.00	.00	2698.00	.00	2000.00	8800.00	4217.00	.00
1968	3843.00	.00	1334.00	.00	.00	17203.00	2931.00	.00
1969	22954.00	.00	6041.00	.00	36000.00	62000.00	4322.00	.00
1970	8400.00	.00	242.00	.00	.00	2400.00	1569.00	.00
1971	.00	.00	732.00	.00	11000.00	3200.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.00	.00
1973	4318.00	.00	1015.00	.00	.00	12400.00	1450.00	.00
COL SUM	180934.00	36507.00	69954.00	51630.00	202310.00	553348.00	56018.00	43535.00
COL MEAN	4639.33	937.62	1793.50	1323.85	5197.44	14186.41	1450.44	1116.28
COL RATIO	.91	.18	.35	.26	1.02	2.78	.29	.22

SUMMARY OF ALL CANYONS WITH DESERT BASIN RECORDS. THE LOCATION (LA = LA RIVER; SG = SAN GABRIEL) AND YEARS OF RECORD (EG 59-71) IS ALSO NOTED. YIELDS IN CU YDS/SQ MI.

COLUMN YEARS	(R9) WILSON LA 1963-	(R9) WINERY LA 1969-	(R9) ZACHAU LA 1957-	ROW SUMS	ROW MEANS	ROW RATIOS
1935	.00	.00	.00	43380.00	537.56	.17
1936	.00	.00	.00	224406.00	2493.40	.44
1937	.00	.00	.00	292041.00	3244.46	.57
1938	.00	.00	.00	1101755.00	12241.72	.37
1939	.00	.00	.00	144691.00	1637.68	.81
1940	.00	.00	.00	51113.00	507.92	.24
1941	.00	.00	.00	264704.00	2941.16	.29
1942	.00	.00	.00	61608.00	694.53	.16
1943	.00	.00	.00	340958.00	3787.31	.34
1944	.00	.00	.00	129435.00	1434.17	.34
1945	.00	.00	.00	33488.00	372.09	.27
1946	.00	.00	.00	30700.00	334.22	.40
1947	.00	.00	.00	35987.00	399.86	.41
1948	.00	.00	.00	7675.00	85.28	.30
1949	.00	.00	.00	4609.00	51.21	.35
1950	.00	.00	.00	6764.00	75.16	.50
1951	.00	.00	.00	2119.00	23.54	.87
1952	.00	.00	.00	299827.00	3320.00	.44
1953	.00	.00	.00	35702.00	396.60	.54
1954	.00	.00	.00	86713.00	963.70	.37
1955	.00	.00	.00	104154.00	1157.27	.05
1956	.00	.00	.00	124000.00	1387.73	.66
1957	.00	.00	.00	115431.00	1282.57	1.21
1958	.00	.00	.00	276433.00	3071.48	.96
1959	.00	.00	.00	241195.00	2676.61	.86
1960	.00	.00	.00	89459.00	993.00	.73
1961	.00	.00	.00	121105.00	1334.50	.78
1962	.00	.00	.00	744332.00	8270.02	.59
1963	.00	.00	.00	317600.00	3520.00	1.23
1964	2150.00	.00	.00	110117.00	1223.52	.86
1965	12452.00	.00	.00	435821.00	4842.46	.90
1966	2224.00	.00	.00	780361.00	8670.68	.86
1967	11248.00	.00	.00	587030.00	6532.56	.80
1968	6550.00	.00	.00	272931.00	3033.12	.99
1969	658.00	.00	.00	2922055.00	32532.83	.95
1970	21511.00	52222.00	29428.00	232554.00	2585.93	1.19
1971	1035.00	.00	.00	142800.00	1587.10	1.36
1972	.00	.00	.00	35798.00	397.76	.57
1973	3333.00	8808.00	.00	535675.00	5951.94	1.11

COL SUM	61219.00	6110.00	34872.00	11306413.00		
COL MEAN	1569.72	1566.92	894.15	292215.71		
COL RATIO	.31	.31	.18	57.29		

LOS ANGELES WATERSHED SYSTEM (LAWS)
DEBRIS PRODUCTION OF 50 DEBRIS BASINS FOR 1972-73
DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1972-73 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALISO	2.77	5342	6283	2238	.418944
ALTADENA	.2	5342	0	0	0
ARBOR DELL	.11	5342	0	0	0
AUBURN	.19	5342	1100	5789	1.08368
BAILEY	.6	5342	0	0	0
BEATTY	.27	5342	1800	6666	1.24785
BELL	7	5342	5300	757	.141707
BIG DALTON	2.62	5342	5100	1946	.364283
BLANCHARD	.5	5342	0	0	0
BLUEGUM	.19	5342	1100	5789	1.08368
BRACE	.29	5342	2000	6896	1.2989
BRADBURY	.68	5342	7000	10294	1.92699
BRAND	1.03	5342	7100	6893	1.29834
CARRIAGE HOUSE	.03	5342	233	6666	1.24785
CARTER	.12	5342	0	0	0
CHILDS	.31	5342	2200	7096	1.32834
CLOUD	.02	5342	0	0	0
COOKS	.58	5342	4100	7003	1.3231
DECK	.59	5342	3000	5084	.951703
DUNSAIR	.84	5342	7200	8571	1.60440
EAGLE	.61	5342	9300	15200	2.8538
ELMWOOD	.51	5342	0	0	0
EMERALD EAST	.16	5342	400	2500	.46799
ENGLEWILD	.4	5342	0	0	0
FAIROAKS	.21	5342	1100	5238	.980532
FERR	.5	5342	0	0	0
GOLF CLUB	.32	5342	2700	8437	1.57937
GOULD	.47	5342	5800	18723	3.50487
HAINES	1.53	5342	0	0	0
HALLS	1.05	5342	17300	16320	3.005584
HARROW	.43	5342	1300	4100	.783602
HAYEN WAY	.22	5342	0	0	0
HAY	.2	5342	1500	7500	1.40397
HILLCREST	.30	5342	500	1428	.207316
HUG	.3	5342	0	0	0
HOOK EAST	.18	5342	0	0	0
HOOK WEST	.17	5342	0	0	0
KINNELUA	.2	5342	4700	23500	4.3991
KINNELUA WEST	.16	5342	7000	43750	9.12583
LANNAN	.25	5342	11300	44800	8.23062
LAS FLORES	.65	5342	2500	5555	1.03987
LA TUNA	5.34	5342	4300	749	.14021
LIMEKILN	3.69	5342	20600	3001	1.50150
LINCOLN	.5	5342	0	0	0
LITTLE DALTON	5.31	5342	23600	7129	1.33452
MAPDOCK	.20	5342	100	400	.074873
MAY NO 1	.7	5342	14300	20423	3.82404
MAY NO 2	.09	5342	2300	25555	4.78379
MORGAN	.6	5342	0	0	0
NICHOLS	.94	5342	2400	2553	.477911
PICKENS	1.04	5342	10100	5489	1.02752
ROWLEY	.50	5342	0	0	0
RODIO	1.26	5342	19400	15390	2.83207
ROBY LOWER	.28	5342	1400	5000	.935979
SANTA ANITA	1.7	5342	32300	19000	3.55072
SAMPIT	2.84	5342	35600	12535	2.34050
SCHOLL	.66	5342	3500	5303	.992699
SCHOOL HOUSE	.20	5342	2600	9205	1.73811
SHIELDS	.27	5342	2000	9027	1.60251
SIERRA MAURE	2.39	5342	30300	12003	2.39067
SIERRA MAURE V	1.40	5342	49300	35767	6.32104
SROVER	.23	5342	1900	8200	1.54624
SOMBREDO	1.00	5342	0	0	0
SPIRKS	.44	5342	0	0	0
STETSON	.29	5342	0	0	0
STONER	1.65	5342	1800	1090	.204043
STURTEVANT	.03	5342	0	0	0
SULLIVAN	2.53	5342	11600	4073	.912205
SUNNYSIDE	.02	5342	100	5000	.935979
SUNSET LOWER	.00	5342	0	0	0
SUNSET UPPER	.44	5342	1900	4310	.808311
TURNBULL	.49	5342	1000	1810	.340322
VERUGO	9.97	5342	19100	1015	.35848
WARD	.1	5342	0	0	0
WEST KAYNE	.25	5342	3100	12400	2.32123
WILCOX	2.00	5342	3500	1450	.271434
WILDTOWN	.05	5342	4000	6153	1.15102
WILSON	2.58	5342	3000	5333	.625924
WINERY	.13	5342	1000	6803	1.06384
ZACHAJ	.55	5342	0	0	0
COLUMB DUMS	84.321		450500	535675	100.276
COLUMB DEANS	1.004		5631.25	6045.94	1.23345

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 19 DEBRIS BASINS FOR 1971-72
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1971-72 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 2/COL 3)
ALISO	2.77	697	0	0	0
ALTAVENA	.2	697	0	0	0
ARKOK DELL	.12	697	0	0	0
AUBURN	.19	697	0	0	0
BAILEY	.6	697	0	0	0
BEATTY	.27	697	0	0	0
BELL	7	697	0	0	0
BIG DALTON	2.62	697	7600	2900	4.16069
BLANCHARD	.5	697	0	0	0
BLUEGUM	.19	697	0	0	0
BRACE	.29	697	0	0	0
BRADBURY	.68	697	0	0	0
BRAND	1.43	697	0	0	0
CARRIAGE HOUSE	.03	697	0	0	0
CARTER	.12	697	0	0	0
CHILD	.31	697	0	0	0
COOKS	.58	697	0	0	0
DEEK	.59	697	0	0	0
DUNSHUIR	.84	697	0	0	0
EAGLE	.61	697	0	0	0
ELWOOD	.31	697	0	0	0
EMERALD EAST	.16	697	0	0	0
ENGLEWILD	.4	697	0	0	0
FAIROAKS	.21	697	0	0	0
FERN	.3	697	0	0	0
GOLF CLUB	.32	697	0	0	0
GOULD	.47	697	0	0	0
HAINES	1.53	697	0	0	0
HALLS	1.46	697	7300	6836	9.87948
HARROW	.43	697	0	0	0
HAVEN WAY	.22	697	0	0	0
HAY	.2	697	0	0	0
HILLCREST	.35	697	0	0	0
HOG	.3	697	0	0	0
HOOK EAST	.18	697	0	0	0
HOOK WEST	.17	697	0	0	0
KINNELOA	.2	697	0	0	0
KINNELOA WEST	.16	697	0	0	0
LAKESH	.25	697	0	0	0
LAS FLORES	.45	697	0	0	0
LA TUNA	5.34	697	0	0	0
LINCOLN	3.69	697	0	0	0
LINCOLN	.5	697	0	0	0
LITTLE DALTON	3.31	697	0	0	0
MAUDOCK	.25	697	0	0	0
MAY RD 1	.7	697	0	0	0
MAY RD 2	.89	697	0	0	0
MORGAN	.6	697	0	0	0
NICHOLS	.94	697	0	0	0
PICKENS	1.84	697	0	0	0
ROWLEY	.58	697	0	0	0
RUBIO	1.26	697	0	0	0
RUBY LOWER	.28	697	0	0	0
SANTA ANITA	1.7	697	43703	25705	36.8795
SANPAT	2.84	697	0	0	0
SCHOLL	.66	697	0	0	0
SCHOOL HOUSE	.28	697	0	0	0
SHIELDS	.27	697	0	0	0
SIERRA MAURE	2.39	697	0	0	0
SIERRA MAURE V	1.46	697	0	0	0
SHOVER	.23	697	0	0	0
SOMBRERO	1.06	697	0	0	0
SPINKS	.44	697	0	0	0
STEFSON	.29	697	0	0	0
STUJON	1.65	697	0	0	0
STURTLIVANT	.33	697	0	0	0
SULLIVAN	2.38	697	0	0	0
SUNNY-SIDE	.72	697	0	0	0
SUNSET LOWER	.65	697	0	0	0
SUNSET UPPER	.44	697	0	0	0
TURNBULL	.79	697	0	0	0
VERDUGO	9.97	697	0	0	0
WARD	.1	697	0	0	0
WEST KAVINE	.25	697	0	0	0
WILSON	5.86	697	0	0	0
WILSON	.65	697	234	347	440459
WILSON	2.58	697	0	0	0
WINTER	.18	697	0	0	0
ZACHARY	.35	697	0	0	0
COLUMN SUMS	84.310		58000	35793	51.5601
COLUMN MEANS	1.46722		744.344	423.139	650123

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 70 DEBRIS BASINS FOR 1970-71
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1970-71 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALISO	2.77	1103	6500	3008	2.03801
ALTADENA	.2	1163	0	0	0
AUBURN	.19	1163	0	0	0
BAILEY	.6	1163	0	0	0
BEATTY	.2	1163	0	0	0
BELL	7	1163	10800	1542	1.32588
BIG DALTON	2.62	1163	0	0	0
BLANCHARD	.5	1163	500	1000	.859845
BLUEGUM	.19	1163	0	0	0
BRAUBURY	.68	1103	900	1323	1.13758
BRAND	1.03	1163	0	0	0
CARRIAGE HOUSE	.03	1163	0	0	0
CARTER	.12	1163	0	0	0
CHILDS	.31	1163	0	0	0
COOKS	.58	1163	0	0	0
DEER	.59	1103	3100	5254	4.51763
DUNSMuir	.84	1103	0	0	0
EAGLE	.61	1163	0	0	0
ELMWOOD	.31	1163	0	0	0
EMERALD EAST	.10	1163	900	5625	4.83663
ENGLEWIL	.4	1163	0	0	0
FAIROAKS	.21	1163	0	0	0
FERN	.3	1103	1900	6333	5.4454
GOLF CLUB	.32	1163	0	0	0
GOULD	.47	1163	3300	7021	6.03697
HAINES	1.53	1163	0	0	0
HALLS	1.06	1163	0	0	0
HARROW	.43	1163	0	0	0
HAY	.2	1163	0	0	0
HILLCREST	.35	1163	0	0	0
HUG	.3	1103	0	0	0
HOOK EAST	.18	1163	0	0	0
HOOK WEST	.17	1163	0	0	0
KINNELOW	.2	1163	600	3000	2.57954
KINNELOW WEST	.16	1163	1000	6250	5.37403
LANHAM	.23	1163	15000	66000	51.5907
LAS FLORES	.45	1103	0	0	0
LA TUNA	3.34	1163	0	0	0
LIBERLIN	3.69	1163	23100	6263	5.39263
LINCOLN	.5	1163	1300	2600	2.23504
LITTLE DALTON	3.31	1103	0	0	0
MAVOCK	.25	1103	0	0	0
MAY NO 1	.7	1163	0	0	0
MAY NO 2	.09	1103	0	0	0
MORGAN	.6	1163	0	0	0
NICHOLS	.94	1163	0	0	0
PICKENS	1.84	1163	5100	4402	3.78504
ROWLEY	.58	1163	2200	3793	3.20139
RUSLO	1.26	1163	0	0	0
RUBY LOWER	.28	1163	0	0	0
SANTA ANITA	1.7	1163	0	0	0
SANMIT	2.84	1103	0	0	0
SCHOLL	.66	1163	0	0	0
SCHOOL HOUSE	.23	1163	0	0	0
SHIELDS	.27	1163	0	0	0
SIERRA MADRE	2.59	1163	0	0	0
SIERRA MADRE V	1.46	1163	0	0	0
SNOVER	.23	1163	0	0	0
SOGOMERO	1.06	1163	300	283	.243336
SPINKS	.44	1103	0	0	0
STEISUN	.29	1103	0	0	0
STOUGH	1.05	1163	0	0	0
STURTEVANT	.03	1163	0	0	0
SULLIVAN	2.38	1103	0	0	0
SUNNYSIDE	.02	1163	0	0	0
SUNSET LOWER	.65	1163	1200	2769	2.38891
SUNSET UPPER	.44	1103	0	0	0
TURNBULL	.99	1163	0	0	0
VERDUGO	9.97	1103	7500	732	.629407
WARD	.1	1163	1100	11000	9.45230
WEST RAVINE	.25	1103	800	3200	2.75151
WILBUR	5.86	1163	0	0	0
WILWOOD	.65	1163	4800	7380	6.34910
WILSON	2.50	1163	0	0	0
WINERY	.18	1163	0	0	0
ZACHAU	.35	1163	0	0	0
COLUMN SUMS	83.610		97300	142859	122.319
COLUMN MEANS	1.10913		1200.20	1679.46	1.01545

LOS ANGELES WATERSHED SYSTEM (LAWS)
 SEBRIS PRODUCTION OF 70 SEBRIS BASINS FOR 1967-70
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1964-70 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.2	2168	0	0	0
AUBURN	.19	2168	0	0	0
BAILEY	.6	2168	6700	10333	4.76414
BELL	.7	2168	3400	485	.223763
BIG DALTON	2.62	2168	8300	3167	1.46879
BLANCHARD	.5	2168	100	210	.092251
BLUE OAK	.17	2168	0	0	0
BRADDOCK	.68	2168	3000	11764	5.42628
BRAND	1.03	2168	0	0	0
CARTER	.12	2168	0	0	0
CHILDS	.31	2168	100	322	.145524
COONS	.58	2168	700	1206	.556273
DEER	.59	2168	3	0	0
DUNSMUIR	.34	2168	1100	1349	.603782
EAGLE	.01	2168	100	103	.075185
ELMHOOD	.31	2168	0	0	0
EMERALD EAST	.16	2168	0	0	0
ENGLEWILD	.4	2168	5500	13750	6.34225
FAIRBANKS	.21	2168	900	4205	1.97648
FERN	.3	2168	2300	6600	3.07472
GOULD	.47	2168	200	425	.196853
HAINES	1.53	2168	0	0	0
HALLS	1.00	2168	0	0	0
HARROW	.43	2168	2400	5531	2.57426
HAY	.2	2168	0	0	0
HILLCREST	.35	2168	800	2285	1.05397
HUG	.3	2168	0	0	0
HUK EAST	.13	2168	1000	5535	2.56227
KINNELDA	.2	2168	500	2300	1.05314
KINNELDA WEST	.16	2168	1300	8125	3.74769
LANNAY	.25	2168	16200	72500	33.5793
LAS FLORES	.45	2168	0	0	0
LA TUNA	5.34	2168	0	0	0
LIMEKILN	3.69	2168	0	0	0
LINCOLN	.5	2168	600	1200	.553506
LITTLE DALTON	3.31	2168	22200	6700	3.09317
MADDOCK	.25	2168	0	0	0
MAY #1	.7	2168	8900	12714	5.86439
MAY #2	.89	2168	400	4444	2.04982
MCCUNE	.62	2168	0	0	0
MURRAY	.6	2168	0	0	0
NICHOLS	.94	2168	5000	3171	1.47186
PICKENS	1.04	2168	0	0	0
ROULEY	.58	2168	0	0	0
RUBIO	1.26	2168	900	714	.329336
RUBY	.28	2168	600	2142	.980107
SANTA ANITA	1.7	2168	31300	18411	8.49216
SAMPIT	2.54	2168	2600	915	.422048
SCHULL	.66	2168	0	0	0
SCHOOLHOUSE	.28	2168	0	0	0
SHIELDS	.27	2168	400	1481	.683118
SIERRA MADRE	2.39	2168	16000	6674	3.08704
SIERRA MADRE V	1.40	2168	0	0	0
STOVER	.23	2168	0	0	0
SUMBRER	1.26	2168	0	0	0
SPINKS	.44	2168	0	0	0
STEINSON	.29	2168	1200	4137	1.90821
STOUGH	1.65	2168	0	0	0
SUNSET	.35	2168	100	3353	1.53736
SUNSET LOWER	.05	2168	0	0	0
SUNSET UPPER	.44	2168	3700	8409	3.87069
TIPNBULL	.77	2168	0	0	0
VERDUCCO	9.47	2168	2300	242	.111024
WARD	.1	2168	0	0	0
WEST RAVINE	.25	2168	600	2400	1.10781
WILBJA	5.06	2168	9200	1569	.723708
WILWOOD	.65	2168	1200	1640	.851476
WILSON	2.50	2168	2600	1035	.500461
WINERY	.18	2168	0	0	0
ZACHAU	.35	2168	0	0	0
COLUMN SUMS	77.840		168500	232554	197.257
COLUMN MEANS	1.112		2411.45	3322.20	1.53250

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 67 DEBRIS BASINS FOR 1964-65
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1964-65 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALLEY RES.	.49	34288	1188	12222	.356534
ALTAVENA	.02	34288	1500	75000	.218734
AUBURN	.19	34288	4688	45203	1.32334
BAILEY	.06	34288	51488	53166	1.55893
BIG DALTON	2.02	34288	295788	113244	3.3435
BLANCHARD	.45	34288	15788	31888	.927655
BLUE GUM	.19	34288	33088	17368	.506651
BRADBURY	.08	34288	78788	183235	3.81152
BRAND	1.03	34288	39488	38252	1.11537
CARTER	.12	34288	27088	22588	.656354
CHILDS	.31	34288	5588	17741	.517552
COOKS	.58	34288	16788	32241	.948519
DEER	.59	34288	44288	74915	2.18539
DUNSMUIR	.84	34288	17588	28955	.808754
EAGLE	.61	34288	12788	28818	.7322
EL WOOD	.31	34288	5988	19232	.555193
EMERALD EAST	.16	34288	1688	18888	.291715
ENGLEHILL	.4	34288	68288	158588	4.39332
FAIROAKS	.21	34288	12888	59523	1.73838
FERN	.3	34288	23988	79666	2.32578
GOULD	.47	34288	15588	32978	.962419
HAINES	1.53	34288	31788	28718	.634376
HALLS	1.06	34288	55288	52475	1.51911
HARRON	.43	34288	63488	147441	4.31188
HAY	.02	34288	5788	28588	.831554
HILLCREST	.35	34288	18388	24288	.35346
HOOK EAST	.18	34288	48288	223333	6.51497
KINNEDJA	.02	34288	17888	85888	2.50718
KINNEDJA WEST	.16	34288	22288	138788	4.04755
LANNAN	.25	34288	4588	18888	.525358
LAS FLORES	.45	34288	19988	44242	1.27882
LA TUNA	5.54	34288	67388	12632	.36762
LIKELIN	3.69	34288	36588	9891	.288336
LINCOLN	.5	34288	28488	56888	1.65694
LITTLE DALTON	3.31	34288	357388	132884	2.97787
MAVOOK	.25	34288	11888	44888	1.28355
MAY #1	.07	34288	45888	65428	1.98864
MAY #2	.09	34288	4188	45555	1.32391
MCCUNE	.02	34288	3188	5888	.145888
MORGAN	.06	34288	13888	21888	.63283
NICHOLS	.94	34288	8188	8489	.189294
PICKENS	1.84	34288	45488	26388	.767323
ROWLEY	.58	34288	11388	19482	.56832
RUBIO	1.26	34288	35888	43888	1.27334
RUBY	.28	34288	5388	29642	.864782
SANTA ANITA	1.7	34288	131788	77538	2.26336
SAN PIT	2.84	34288	233388	82323	2.44149
SCHOLL	.06	34288	3588	5388	.154697
SCHOOLHOUSE	.28	34288	1688	5714	.186886
SHIELDS	.27	34288	3388	12222	.356534
SIERRA MAURE	2.39	34288	97888	48836	1.19125
SIERRA MAURE V	1.46	34288	185788	72534	2.11593
SHOYER	.23	34288	11288	48895	1.42851
SPINKS	.44	34288	16488	37272	1.88728
STOUGH	1.65	34288	1888	1888	.831797
STURTEVANT	.43	34288	388	18888	.291715
SUNSET LOWER	.65	34288	11888	17892	.518183
SUNSET UPPER	.44	34288	18188	22934	.649883
TURBIDILL	.99	34288	12788	18888	.483495
VERUGO	18.43	34288	88588	6841	.178225
WARD	.1	34288	3888	38888	1.18813
WEST KAVINE	.25	34288	15888	62888	1.38364
WILBUR	8.63	34288	37388	4322	.128479
WILWOOD	.05	34288	16888	24615	.718857
WILSON	2.58	34288	55588	21811	.627589
WINERY	.18	34288	9488	52222	1.52848
ZACHAU	.35	34288	18388	29428	.85846
COLUMN SUMS	72.618		2,4891E+6	2,82881E+6	95.4146
COLUMN MEANS	1.28873		37158.7	43781.7	1.27884

LOS ANGELES WATERSHED SYSTEM (LAWS)
DEBRIS PRODUCTION OF 31 DEBRIS BASINS FOR 1967-68
DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1967-68 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.02	3076	0	0	0
AUBURN	.19	3076	0	0	0
BAILEY	.00	3076	0	0	0
Big DALTON	2.64	3076	10000	3810	1.24057
BRADLEY	.08	3076	1400	2050	.669351
BRAND	1.03	3076	2000	1941	.631014
CARTER	.12	3076	0	0	0
CHILDS	.31	3076	0	0	0
COOKS	.58	3076	1400	2413	.78446
DEER	.59	3076	4000	6779	2.20384
DUNSMuir	.84	3076	600	714	.23212
EAGLE	.61	3076	1400	2295	.740099
ELWOOD	.31	3076	300	967	.314360
EMERALD EAST	.16	3076	0	0	0
ENGLEWILD	.04	3076	0	0	0
FAIROAKS	.21	3076	3500	16660	5.41833
FERN	.03	3076	5000	18000	5.85176
GOULD	.47	3076	5000	11914	3.87321
HAINES	1.53	3076	7700	5052	1.63519
HALLS	1.06	3076	5500	5108	1.64061
HARROW	.43	3076	0	0	0
HAY	.02	3076	2300	11503	3.73862
HILLCREST	.35	3076	0	0	0
KINNELOA	.02	3076	3000	17000	5.52666
KINNELOA WEST	.16	3076	4200	26250	8.53381
LANNAN	.25	3076	0	0	0
LAS FLORES	.45	3076	3700	6222	2.07275
LA TUNA	5.34	3076	0	0	0
LIMERLIN	3.09	3076	15500	4200	1.36541
LINCOLN	.05	3076	1700	3400	1.10533
LITTLE DALTON	3.51	3076	5500	1601	.539987
MAUDUCA	.25	3076	200	800	.260073
MAY #1	.07	3076	11000	16357	5.40317
MAY #2	.09	3076	1600	20000	6.50175
MCCLORE	.02	3076	0	0	0
MURKIN	.06	3076	0	0	0
NICHOLS	.94	3076	3500	3510	1.14139
PICKENS	1.84	3076	500	271	.088101
ROWLEY	.50	3076	300	517	.168075
RUBIO	1.20	3076	0	0	0
RUBY	.28	3076	300	1071	.348179
SANTA AVITA	1.7	3076	6500	3823	1.24285
SARPII	2.34	3076	9500	5274	1.60437
SCHULL	.06	3076	1700	2575	.837120
SCHOOLHOUSE	.28	3076	0	0	0
SHIELDS	.47	3076	1200	4444	1.44473
SIERRA MADRE	2.39	3076	2200	920	.29407
SIERRA MADRE V	1.40	3076	36000	24731	6.10501
SHOVER	.23	3076	0	0	0
SPIGAS	.44	3076	400	900	.295014
STOUGH	1.05	3076	0	0	0
SUNSET LOWER	.65	3076	0	0	0
SUNSET UPPER	.44	3076	1700	3803	1.25585
TURBULL	.99	3076	9700	9797	3.18498
VERUGO	9.97	3076	13000	1304	.449935
WARD	.01	3076	0	0	0
WEST RAVINE	.25	3076	4500	17200	5.59163
WILBUR	0.63	3076	25300	2931	.952061
WILWOOD	.05	3076	2100	3230	1.35007
WILSON	2.38	3076	1700	608	.213914
ZACHAU	.35	3076	0	0	0
COLUMN SUMS	71.300		219600	272931	82.7454
COLUMN MEANS	1.17016		3600	4475.10	1.45484

LOS ANGELES WATERSHED SYSTEM (LAWS)
DEBRIS PRODUCTION OF DEBRIS BASINS FOR 1900-07
DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1906-07 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTAVERNA	.02	8146	0	0	0
AUBURN	.19	8146	2800	14736	1.80899
BAILEY	.06	8146	630	1000	.12270
BIG DALTON	2.62	8146	94200	35954	4.4137
BRADDOCK	.68	8146	4700	6911	.848392
BRAND	1.23	8146	10700	10502	1.29904
CARTER	.12	8146	1300	10333	1.32986
CHILDS	.31	8146	2800	9032	1.10877
COOBS	.53	8146	0	0	0
DEER	.59	8146	8800	14910	1.83096
DUNSMUIR	.84	8146	2000	2384	.292103
EAGLE	.51	8146	9700	15901	1.952
ELMWOOD	.31	8146	3200	10322	1.20713
EMERALD EAST	.16	8146	300	1875	.230174
ENGLEWILL	.4	8146	1100	2750	.337589
FAIRWAYS	.21	8146	1500	7142	.876749
FERA	.03	8146	4800	16000	1.96415
GOULD	.47	8146	0	0	0
HAINES	1.53	8146	0	0	0
HALLS	1.06	8146	6900	4509	.799042
HARROW	.43	8146	400	930	.114166
HAY	.02	8146	300	1500	.184139
HILLCREST	.35	8146	900	2571	.315615
KINNELOA	.02	8146	4400	22000	2.70371
KINNELOA WEST	.10	8146	3900	24375	2.99227
LARNAN	.25	8146	2500	10000	1.22700
LAS FLORES	.45	8146	1500	2800	.35453
LA TUNA	5.34	8146	5000	1048	.123652
LIMEKILN	3.69	8146	25000	6937	.851584
LINCOLN	.05	8146	0	0	0
LITTLE DALTON	3.31	8146	71000	21450	2.63319
MADDOCK	.25	8146	1000	4000	.491839
MAY #1	.07	8146	6400	92000	11.2934
MAY #2	.09	8146	6200	68000	8.45007
MCCLURE	.62	8146	2700	4077	.574147
MORGAN	.00	8146	200	333	.040079
NICHOLS	.94	8146	3500	3723	.457034
PICKENS	1.04	8146	6000	3675	.453597
ROWLEY	.58	8146	4200	7241	.880903
RUBIO	1.26	8146	12100	9603	1.17886
RUBY	.28	8146	600	2142	.262951
SANTA ANITA	1.7	8146	71500	42053	5.16303
SARFIT	2.84	8146	16200	5704	.700221
SCHULL	.60	8146	1000	1515	.185901
SCHOOLHOUSE	.28	8146	1100	3920	.4822
SHIELDS	.27	8146	6000	22222	2.72797
SIERRA MADRE	2.39	8146	0	0	0
SIERRA MADRE V	1.46	8146	13200	9041	1.10987
SNOVER	.25	8146	1200	5217	.640437
SPINKS	.44	8146	4100	9318	1.14387
STOUGH	1.65	8146	2000	1212	.144785
SUNSET LOWER	.65	8146	1200	1840	.220014
SUNSET UPPER	.44	8146	1100	2500	.306099
TUNHILL	.99	8146	1400	1414	.173532
VERDUGO	9.97	8146	26000	2688	.329978
WARD	.01	8146	200	2000	.245519
WEST RAVINE	.25	8146	2000	8000	1.000029
WILBUR	0.63	8146	30400	4217	.517677
WILSON	2.56	8146	16000	6250	.804170
ZACHAU	.35	8146	300	857	.102235
COLUMN SUMS	70.731		570200	587930	72.1741
COLUMN MEANS	1.17003		9603.33	9794.83	1.2029

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 60 DEBRIS BASINS FOR 1965-66
 DATA PROVIDED BY THE L.A. COUNTY FLUOM CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1965-66 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.5	18114	0	0	0
AUBURN	.19	18114	5223	27473	2.71033
BAILEY	.6	18114	0	0	0
BIG DALTON	2.62	18114	23075	9112	.988929
BRANDURY	.64	18114	23723	34886	3.44928
BRAND	1.03	18114	28123	19535	1.93158
CARTER	.12	18114	0	0	0
CHILDS	.31	18114	5364	17367	1.71713
COOKS	.53	18114	6412	11855	1.81304
DEER	.59	18114	19803	33780	3.53202
DUNSMUIR	.84	18114	0	0	0
EAGLE	.61	18114	15769	25853	2.55586
ELMWOOD	.31	18114	5831	18389	1.85978
EMERALD EAST	.10	18114	0	0	0
ENGLEWILD	.4	18114	1218	3042	.301868
FAIRDAKS	.21	18114	5934	28257	2.79385
FERN	.3	18114	18666	35553	3.51523
GOULD	.47	18114	18813	38325	3.7873
HAINES	1.53	18114	1101	758	.874946
HALLS	1.86	18114	5536	5222	.516314
HARROW	.43	18114	0	0	0
HAY	.2	18114	2206	11838	1.89057
HILLCREST	.35	18114	2289	6311	.623937
KINNELOA	.2	18114	6945	34725	3.43336
KINNELOA WEST	.10	18114	0	0	0
LANNAN	.25	18114	0	0	0
LAS FLORES	.45	18114	17387	38450	3.83265
LA TUNA	5.34	18114	26885	5019	.496243
LIMEKILN	3.09	18114	42316	11467	1.13378
LINCOLN	.5	18114	6153	12306	1.21673
LITTLE DALTON	3.31	18114	47780	14435	1.42723
MADDOCK	.25	18114	3514	14356	1.38975
MAY #1	.7	18114	7446	10637	1.05171
MAY #2	.89	18114	842	9355	.924955
MCCLORE	.62	18114	3311	5348	.527981
MORGAN	.6	18114	0	0	0
NICHOLS	.94	18114	9894	9674	.956496
PICKENS	1.84	18114	44564	24219	2.3946
ROWLEY	.58	18114	3861	6691	.661553
RUBIO	1.26	18114	22234	17046	1.74471
RUBY	.28	18114	0	0	0
SANTA ANITA	1.7	18114	32576	19162	1.8946
SAWPIE	2.84	18114	35775	12397	1.2455
SCHOLL	.66	18114	1815	1537	.151968
SCHOOLHOUSE	.28	18114	5118	18278	1.88720
SHIELDS	.27	18114	9328	34518	3.41239
SIERRA MAURE	2.39	18114	1736	726	.871722
SIERRA MADRE V	1.46	18114	51356	35161	3.47647
SNOVER	.23	18114	1444	6278	.628724
SPINKS	.44	18114	1936	4480	.435241
STOUGH	1.65	18114	8348	5054	.499743
SUNSET LOWER	.65	18114	14726	22655	2.23996
SUNSET UPPER	.44	18114	8803	28143	1.99108
TURNBULL	.99	18114	780	793	.873406
VERDUGO	18.85	18114	36108	3688	.355942
WARD	.41	18114	681	6818	.673324
WEST RAVINE	.25	18114	7647	38425	3.8885
WILBUR	8.63	18114	57429	6654	.6679
WILSON	2.58	18114	29020	11248	1.11212
ZACHAU	.35	18114	0	0	0
COLUMN SUMS	71.118		71922	760361	77.1555
COLUMN MEANS	1.18517		11987.5	13086.8	1.28594

LOS ANGELES WATERSHED SYSTEM (LAWS)
DEBRIS PRODUCTION OF 63 DEBRIS BASINS FOR 1964-65
DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1964-65 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTAVENA	.51	5369	0	0	0
AUBURN	.19	5369	0	0	0
BAILEY	.06	5369	0	0	0
BIG DALTON	2.62	5369	0	0	0
BRAUDJRY	.00	5369	0	0	0
BRAND	1.05	5369	46360	45009	8.38313
CARTER	.12	5369	0	0	0
CHILDS	.31	5369	8231	26551	4.94524
COOKS	.58	5369	0	0	0
DEER	.59	5369	22524	38170	7.11045
DUNSMUIR	.84	5369	0	0	0
EAGLE	.61	5369	2876	3483	.633824
ELMWOOD	.31	5369	5823	18783	3.49342
EMERALD EAST	.16	5369	0	0	0
ENGLEHIL	.4	5369	0	0	0
FAIROAKS	.21	5369	0	0	0
FERN	.3	5369	1313	4370	.815349
GOULD	.47	5369	5234	11242	2.09387
HAINES	1.33	5369	0	0	0
HALLS	1.86	5369	0	0	0
HARROW	.43	5369	0	0	0
HAY	.2	5369	0	0	0
HILLCREST	.35	5369	11659	33311	6.20432
KINFLOA	.2	5369	0	0	0
LANNAN	.25	5369	0	0	0
LAS FLORES	.40	5369	0	0	0
LA LUNA	5.34	5369	0	0	0
LIMEKILN	3.69	5369	4009	1108	.28637
LINCOLN	.5	5369	0	0	0
LITTLE DALTON	3.31	5369	0	0	0
MADDUCK	.25	5369	0	0	0
MAY #1	.7	5369	135	192	.055701
MAY #2	.09	5369	0	0	0
MCCLURE	.02	5369	29612	47701	3.89570
MORGAN	.6	5369	0	0	0
NICHOLS	.94	5369	906	963	.179363
PARADISE	.58	5369	0	0	0
PICKENS	1.84	5369	0	0	0
ROWLEY	.58	5369	0	0	0
RUBIO	1.26	5369	0	0	0
RUBY	.28	5369	0	0	0
SANTA ANITA	1.7	5369	28045	16854	3.013839
SANPAT	2.84	5369	78075	27702	5.15962
SCHULL	.66	5369	0	0	0
SCHOOLHOUSE	.28	5369	0	0	0
SHIELDS	.27	5369	2399	8895	1.65407
SIERRA MADRE	2.39	5369	0	0	0
SIERRA MADRE V	1.46	5369	0	0	0
SHOVER	.23	5369	0	0	0
SPINKS	.44	5369	0	0	0
STOUGH	1.65	5369	44168	26768	4.98566
SUNSET LOWER	.65	5369	38244	58836	10.9535
SUNSET UPPER	.44	5369	27037	61447	11.4448
TURBULL	.99	5369	0	0	0
VERDUGO	10.85	5369	13781	1371	.255355
WARU	.1	5369	0	0	0
WEST RAVINE	.25	5369	0	0	0
WILBUR	3.63	5369	7452	863	.100730
WILSON	2.58	5369	2738	2224	.41423
ZACHAU	.53	5369	0	0	0
COLUMB SUMS	71.541		384151	435821	81.1736
COLUMB MEANS	1.19233		6402.52	7203.08	1.35289

LOS ANGELES WATERSHED SYSTEM (LAWS)
DEBRIS PRODUCTION OF 55 DEBRIS BASINS FOR 1953-54
DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1953-54 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	1419	0	0	0
AUBURN	.19	1419	0	0	0
BAILEY	.6	1419	7268	12113	8.53629
BIG JALTON	2.62	1419	0	0	0
BRADDOCK	.68	1419	0	0	0
BRAND	1.35	1419	9932	9642	6.79493
CARTER	.12	1419	695	5791	4.08184
COOKS	.58	1419	0	0	0
DEER	.59	1419	7243	12276	8.65116
DONAMIER	.64	1419	0	0	0
EAGLE	.61	1419	0	0	0
ENGLEWILD	.4	1419	0	0	0
FAIRWAKS	.21	1419	2970	14171	9.98661
FERH	.3	1419	0	0	0
GOOSEJERRY	.26	1419	0	0	0
GOULD	.47	1419	0	0	0
HAINES	1.53	1419	0	0	0
HALLS	1.06	1419	0	0	0
HARKOW	.43	1419	0	0	0
HAY	.2	1419	0	0	0
HILLCREST	.35	1419	8606	24594	17.3319
LA MAN	.25	1419	0	0	0
LAS FLORES	.45	1419	2460	5466	3.85281
LA TUNA	5.34	1419	0	0	0
LINDLEY	.5	1419	0	0	0
LITTLE JALTON	3.51	1419	0	0	0
MADDOCK	.25	1419	0	0	0
MAY #1	.7	1419	0	0	0
MAY #2	.39	1419	0	0	0
MCCLUKE	.02	1419	0	0	0
NICHOLS	.94	1419	0	0	0
PARADISE	.62	1419	0	0	0
PICKENS	1.54	1419	783	425	.299507
ROBLEY	.58	1419	0	0	0
RUBIO	1.26	1419	0	0	0
RUBY	.25	1419	0	0	0
SANTA ANITA	1.7	1419	2419	1422	1.01211
SANPIT	2.24	1419	6747	2440	1.72375
SCHOLL	.66	1419	0	0	0
SCHOOLHOUSE	.23	1419	0	0	0
SHIELDS	.27	1419	0	0	0
SIERRA MADRE	2.39	1419	743	310	.218454
SIERRA MADRE V	1.46	1419	4453	3854	2.61494
SNOW	.23	1419	0	0	0
SPARK	.34	1419	0	0	0
SPINKS	.44	1419	0	0	0
STOUGH	1.65	1419	0	0	0
SUNSET UPPER	.44	1419	2529	5293	3.73809
TURBULL	.99	1419	0	0	0
VERDUGO	18.35	1419	0	0	0
WARD	.1	1419	0	0	0
WEST RAVINE	.25	1419	0	0	0
WILBUR	0.63	1419	5755	666	.469345
WILSON	2.58	1419	32124	12452	8.77519
ZACHAU	.55	1419	0	0	0
COLUMN SUMS	66.708		94739	118117	77.6818
COLUMN MEANS	1.21332		1722.55	2022.15	1.41894

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 54 DEBRIS BASINS FOR 1962-63
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1962-63 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	2879	94	184	.063911
AUBURN	.19	2879	2315	14315	3.14588
BAILEY	.6	2879	1430	2466	.856547
BIG DALTON	2.62	2879	18125	3864	1.34213
BRADBURY	.68	2879	0	0	0
BRAND	1.83	2879	0	0	0
VARICK	.12	2879	1394	13285	4.61376
COOKS	.58	2879	0	0	0
DEER	.39	2879	1504	2549	.845577
DUNSMUIR	.34	2879	3903	4052	1.61584
EAGLE	.61	2879	1173	1963	.681834
ENGLEWILD	.4	2879	1425	3562	1.23724
FAIROAKS	.21	2879	4068	19333	6.71518
FERN	.3	2879	6732	22440	7.79437
GOOSEVEERY	.26	2879	0	0	0
GOULD	.47	2879	3975	3457	2.93748
HAINES	1.53	2879	0	0	0
HALLS	1.06	2879	6167	5836	2.02789
HARROW	.43	2879	0	0	0
HAY	.2	2879	1524	7628	2.64675
LANNAN	.25	2879	3037	12146	4.21952
LAS FLORES	.45	2879	24737	54771	19.8933
LA TUNA	5.34	2879	0	0	0
LINCOLN	.5	2879	797	1594	.556664
LITTLE DALTON	3.31	2879	12994	3925	1.36332
MAPPLECK	.25	2879	0	0	0
MAY #1	.7	2879	0	0	0
MAY #2	.89	2879	0	0	0
MCCLORE	.62	2879	354	578	.197985
NICHOLS	.94	2879	1363	1450	.503647
PARADISE	.02	2879	1646	16871	.585967
PICKENS	1.64	2879	6333	3441	1.19521
ROWLEY	.53	2879	0	0	0
RUBIO	1.26	2879	5913	3978	1.38173
RUDY	.28	2879	355	1267	.440085
SANTA ANITA	1.7	2879	31452	16501	6.42519
SAWPII	2.84	2879	5124	1804	.626506
SCHOLL	.66	2879	683	1834	.359152
SCHOOLHOUSE	.28	2879	21027	77239	26.8284
SHIELDS	.27	2879	0	0	0
SIERRA MAURE	2.39	2879	140	58	.820146
SIERRA MAURE V	1.46	2879	12415	8503	2.95346
SNOVER	.23	2879	0	0	0
SPARR	.84	2879	912	1885	.376867
SPINKS	.44	2879	1634	4168	1.44773
STOUGH	1.65	2879	0	0	0
SUNSET UPPER	.44	2879	0	0	0
TURNBULL	.99	2879	431	4351	.151694
VEPDUGO	10.95	2879	3772	3731	.130254
WARD	.1	2879	497	4978	1.72629
WEST RAVINE	.25	2879	131	224	.162388
WILBUR	8.03	2879	3900	4511	.150652
WILSON	2.58	2879	5578	2158	.749066
ZACHAU	.35	2879	87	243	.096141
COLUMN SUMS	60.418		191225	317063	110.319
COLUMN MEANS	1.22982		3541.2	5881.53	2.04294

LOS ANGELES WATERSHED SYSTEM (LAWS)
DEBRIS PRODUCTION OF 54 DEBRIS BASINS FOR 1961-62
DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1961-62 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	13951	0	0	0
AUBURN	.19	13951	26113	105657	7.58777
BAILEY	.0	13951	10102	10036	1.20648
BIG DALTON	2.62	13951	130374	49701	3.56644
BRAUBURY	.04	13951	12322	188551	1.35152
BRAND	1.03	13951	2470	2403	.172240
CARTER	.12	13951	11155	93441	6.66913
COOKS	.58	13951	987	1701	.121927
DEER	.59	13951	1030	1745	.125881
DUNSTON	.04	13951	2829	3367	.241365
EAGLE	.61	13951	1762	2883	.20141
FAIROAKS	.21	13951	530	2523	.180847
FERN	.5	13951	399	13301	.095334
FLOAL UPPER	.05	13951	837	13430	.099928
GOOSEBERRY	.20	13951	1682	0409	.463594
GOULD	.47	13951	12783	27023	1.09
HAINES	1.53	13951	1755	11471	.082210
HALLS	1.06	13951	14914	14099	1.00646
HARROW	.43	13951	865	2011	.144147
HAY	.2	13951	5638	28048	2.000789
LANHAM	.25	13951	2149	8756	.027025
LAS FLORES	.45	13951	525	1166	.083578
LA LUNA	5.34	13951	20884	5036	.360836
LINCOLN	.5	13951	1046	2092	.144953
LITTLE DALTON	3.31	13951	165600	50470	4.001935
MADDOCK	.25	13951	3070	12314	.087678
MAY #1	.7	13951	2159	3071	.022128
MAY #2	.09	13951	51	505	.040571
MCCLURE	.62	13951	2043	3295	.236154
NICHOLS	.94	13951	5417	5762	.413017
PARADISE	.02	13951	3642	5874	.421045
PICKENS	1.84	13951	10355	50271	.403334
ROWLEY	.58	13951	1142	1903	.141085
RUBIO	1.26	13951	577	457	.032753
RUBY UPPER	.21	13951	1405	6976	.500056
RUBY	.28	13951	1626	5087	.413243
SANTA ANITA	1.7	13951	132001	776471	5.56569
SAWYIT	2.04	13951	60007	23746	1.71644
SCHILL	.60	13951	0	0	0
SHIELDS	.27	13951	1000	3725	.201342
SIERRA MADRE	2.39	13951	11503	4012	.344922
SIERRA MADRE V	1.40	13951	115012	51241	5.82531
SHOVER	.23	13951	080	2936	.211684
SPARK	.84	13951	2235	2025	.183159
SPIKES	.44	13951	2035	5908	.429217
STOUGH	1.65	13951	1402	849	.060550
SUNSET UPPER	.44	13951	0	0	0
TURNBULL	.99	13951	2918	2947	.211239
VERJUGO	1.05	13951	33261	3007	.272384
WARD LOWER	.57	13951	0	0	0
WARD	.1	13951	987	9070	.050133
WEST RAVINE	.25	13951	497	1943	.142499
WILSON	0.03	13951	30888	3579	.220541
ZACHAU	.35	13951	139	397	.028457
COLUMN SUMS	63.990		892702	744302	53.3511
COLUMN MEANS	1.185		16532.6	13783.4	.937984

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 55 DEBRIS BASINS FOR 1960-61.
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1960-61 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	1721	0	0	0
AUBURN	.17	1721	4851	21321	12.3887
BAILEY	.6	1721	2104	3606	2.07529
BIG DALTON	2.62	1721	47554	18143	10.545
BIG DALTON L	.34	1721	780	2294	1.33295
BRADBURY	.68	1721	0	0	0
BRAND	1.03	1721	103	103	.058186
CARTER	.12	1721	0	0	0
COOKS	.58	1721	0	0	0
DEER	.59	1721	0	0	0
DUNSMUIR	.84	1721	2168	2588	1.49913
EAGLE	.61	1721	355	581	.337574
FAIROAKS	.21	1721	25	119	.069146
FERN	.3	1721	729	2434	1.41197
FLOKAL UPPER	.06	1721	63	1133	.653338
GOOSEBERRY	.26	1721	0	0	0
GOULD	.47	1721	3416	7268	4.22313
HAINES	1.53	1721	0	0	0
HALLS	1.00	1721	4139	3904	2.26845
HARRIS	.43	1721	0	0	0
HAY	.2	1721	0036	30100	17.53363
LANHAN	.25	1721	0	0	0
LAS FLORES	.45	1721	167	371	.215572
LA TUNA	5.34	1721	0	0	0
LINCOLN	.5	1721	0	0	0
LITTLE DALTON	3.31	1721	10097	5709	3.31726
MAPPOCK	.25	1721	0	0	0
MAY #1	.7	1721	0	0	0
MAY #2	.09	1721	0	0	0
MCCLORE	.62	1721	0	0	0
NICHOLS	.94	1721	0	0	0
PARADISE	.62	1721	0	0	0
PICKENS	1.84	1721	8180	4445	2.5828
ROWLEY	.58	1721	333	574	.333527
RUBIN	1.26	1721	0	0	0
RUBY UPPER	.21	1721	0	0	0
RUBY	.28	1721	26	92	.053457
SANTA ANITA	1.7	1721	0	0	0
SAMPIT	2.84	1721	2696	947	.558261
SCHOLL	.60	1721	0	0	0
SHIELDS	.27	1721	0	0	0
SIERRA MAURE	2.59	1721	0	0	0
SIERRA MAURE V	1.46	1721	0	0	0
SNOVER	.23	1721	1181	5134	2.98315
SPARK	.84	1721	0	0	0
SPENKS	.44	1721	0	0	0
STOUGH	1.65	1721	0	0	0
SUNSET UPPER	.44	1721	1366	3104	1.8036
TURBULL	.99	1721	250	252	.146426
VERDUGO	10.05	1721	0	0	0
WARD LOWER	.57	1721	0	0	0
WARD	.1	1721	185	1850	1.07496
WEST RAVINE	.25	1721	844	3376	1.96165
WILBUR	8.03	1721	5068	587	.341001
ZACHAU	.35	1721	0	0	0
COLUMN SUMS	64.330		110771	120105	69.7879
COLUMN MEANS	1.10964		2016.02	2183.73	1.20887

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DERRIS PRODUCTION OF 54 DERRIS BASINS FOR 1959-60
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1959-60 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTAVENA	.51	1355	474	927	.685689
AUBURN	.19	1355	0	0	0
BAILEY	.6	1355	0	0	0
BIG DALTON L	.34	1355	774	2276	1.67971
BRADSHAW	.66	1355	3569	5248	3.87386
BRAND	1.35	1355	0	0	0
CARTER	.12	1355	0	0	0
COOKS	.38	1355	0	0	0
DEER	.59	1355	0	0	0
DUNSMUIR	.84	1355	0	0	0
EAGLE	.61	1355	0	0	0
FAIROAKS	.21	1355	2070	9857	7.27454
FERN	.3	1355	0	0	0
FLORAL UPPER	.86	1355	0	0	0
GOOSEBERKY	.26	1355	0	0	0
GOULD	.47	1355	2825	6010	4.43542
HAINES	1.53	1355	0	0	0
HALLS	1.00	1355	0	0	0
HARKOW	.43	1355	0	0	0
HAY	.2	1355	1570	7850	5.79336
LANNAN	.25	1355	0	0	0
LAS FLORES	.45	1355	0	0	0
LA TUNA	5.34	1355	0	0	0
LINCOLN	.5	1355	0	0	0
LITTLE DALTON	3.51	1355	15707	4745	3.50185
MADDOCK	.25	1355	1100	4400	3.24723
MAY #1	.7	1355	0	0	0
MAY #2	.09	1355	0	0	0
MCCLORE	.62	1355	0	0	0
NICHOLS	.94	1355	490	521	.384502
PARADISE	.62	1355	360	580	.428044
PICKENS	1.84	1355	1057	574	.423616
ROWLEY	.58	1355	0	0	0
RUBIO	1.26	1355	0	0	0
RUBY UPPER	.21	1355	0	0	0
RUBY	.28	1355	0	0	0
SANTA ANITA	1.7	1355	15340	8847	6.52915
SAWYER	2.84	1355	16903	5951	4.39188
SCHOLL	.66	1355	0	0	0
SHIELDS	.27	1355	0	0	0
SIERRA MADRE	2.39	1355	0	0	0
SIERRA MADRE V	1.46	1355	0	0	0
SNOVER	.23	1355	0	0	0
SPARK	.34	1355	0	0	0
SPINKS	.44	1355	13519	30725	22.6753
STOUGH	1.65	1355	0	0	0
SUNSET UPPER	.44	1355	0	0	0
TURNBULL	.99	1355	0	0	0
VERDUGO	10.05	1355	0	0	0
WARD LOWER	.57	1355	0	0	0
WARD	.1	1355	0	0	0
WEST RAVINE	.25	1355	0	0	0
WILBUR	8.63	1355	6168	946	.698155
ZACHAU	.35	1355	0	0	0
COLUMN SUMS	61.710		83625	89459	60.4214
COLUMN MEANS	1.14273		1548.63	1650.65	1.22262

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 49 DEBRIS BASINS FOR 1957-58
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1957-58 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (CUL 5/CUL 3)
ALTADENA	.51	3201	3255	6382	1.99375
AMURN	.19	3201	1625	8552	2.67167
BAILEY	.0	3201	1651	2751	.859419
BIG VALTON L	.34	3201	0	0	0
CRABBUCK	.68	3201	3156	4641	1.44986
BRAVO	1.03	3201	1416	1370	.429866
CARTER	.12	3201	742	7183	1.93158
COOKS	.58	3201	252	400	.124761
DEER	.59	3201	2607	4422	1.34164
DUNSHUIK	.04	3201	4692	5545	1.74477
EAGLE	.61	3201	1444	2367	.739456
FAIRDAKS	.21	3201	18704	50771	15.9255
FERN	.3	3201	1111	3703	1.15643
FLORAL UPPER	.06	3201	447	7454	2.32740
FLORAL LOWER	.11	3201	0	0	0
GOULV	.47	3201	3973	8453	2.64074
HAINES	1.53	3201	1167	775	.242117
HALLS	1.00	3201	12167	11478	3.58575
HAY	.2	3201	0	0	0
LANNAN	.25	3201	1137	4548	1.42081
LAS FLORES	.45	3201	1440	3230	.799088
LA TUNA	5.34	3201	10723	2007	.626922
LINGULN	.5	3201	1536	3272	1.02218
MAUDUCK	.25	3201	0	0	0
MAY #1	.7	3201	2218	3160	.989091
MAY #2	.09	3201	0	0	0
MCLURE	.62	3201	9504	15329	4.78042
NICHOLS	.94	3201	1200	1340	.418019
PARADISE	.47	3201	2249	4785	1.49485
PICKENS	1.04	3201	5006	2753	.860844
ROWLEY	.58	3201	1449	2534	.887243
RUBIO	1.26	3201	2012	2231	.69697
RUBY UPPER	.21	3201	211	1034	.313652
RUBY	.28	3201	740	2642	.825367
SANPIE	2.34	3201	21003	7629	2.38332
SCHULL	.66	3201	645	977	.305217
SHIELDS	.27	3201	801	2966	.926555
SIERRA MADRE	2.39	3201	3404	1424	.444061
SHOVER	.23	3201	2175	9456	2.95448
SPARK	.54	3201	3032	3609	1.12746
STOUGH	1.65	3201	7779	4714	1.47267
SUNSET UPPER	.44	3201	1535	3415	1.06605
TURNBULL	.99	3201	955	464	.301156
VERDUJO	10.05	3201	10075	1002	.513027
WARD LOWER	.57	3201	1365	2287	.715039
WARD	.1	3201	5166	51360	16.2012
WEST AVINE	.25	3201	1352	5448	1.68947
WILBUR	8.65	3201	20742	2420	.757808
ZACHAU	.35	3201	1300	3942	1.23149
COLUMN SUMS	54.978		173107	276433	86.3583
COLUMN MEANS	1.10547		3532.80	5641.49	1.76242

LOS ANGELES WATERSHED SYSTEM (LAWS)
 MERRIS PRODUCTION OF 47 MERRIS BASINS FOR 1956-57
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1956-57 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	1058	2078	4058	3.83554
AUBURN	.19	1058	0	0	0
BAILEY	.0	1058	0	0	0
BIG WALTON L	.34	1058	0	0	0
BRADBURY	.68	1058	0	0	0
BRAND	1.03	1058	0	0	0
CARTER	.12	1058	0	0	0
COOKS	.58	1058	0	0	0
DEER	.59	1058	0	0	0
DUNSMUIR	.34	1058	3080	4280	4.05099
EAGLE	.61	1058	500	819	.774102
FAIRDAKS	.21	1058	0	0	0
FEKH	.3	1058	0	0	0
FLORAL UPPER	.46	1058	700	11600	11.0265
FLORAL LOWER	.11	1058	0	0	0
GULF	.47	1058	0	0	0
HAINES	1.53	1058	0	0	0
HALLS	1.06	1058	0	0	0
HAY	.2	1058	0	0	0
LANNAN	.25	1058	0	0	0
LAS FLORES	.45	1058	0	0	0
LA TUNA	5.34	1058	11250	2100	1.99055
LINGULIN	.5	1058	2260	4520	4.27221
MADDOCK	.25	1058	0	0	0
MAY #1	.07	1058	0	0	0
MAY #2	.09	1058	0	0	0
MCCLORE	.62	1058	3700	5967	5.63939
NICHOLS	.94	1058	1200	1680	1.5879
PARADISE	.47	1058	1100	2340	2.21172
PICKENS	1.84	1058	2530	1375	1.29962
ROWLEY	.53	1058	900	1501	1.40597
RUBIO	1.26	1058	0	0	0
RUBY UPPER	.21	1058	2111	10052	9.50095
RUBY	.28	1058	320	2920	2.76749
SAWPIT	2.04	1058	1000	352	.332703
SCHULL	.66	1058	0	0	0
SHIELDS	.27	1058	100	700	.664461
SIERRA MADRE	2.39	1058	0	0	0
SNOWY	.23	1058	1100	4702	4.51985
SPARK	.84	1058	0	0	0
STOUGH	1.65	1058	0	0	0
SUNSET UPPER	.44	1058	800	1810	1.71834
TURNBULL	.99	1058	760	767	.724953
VERBODD	10.05	1058	2760	274	.259979
WARD LOWER	.57	1058	060	1508	1.42335
WARD	.1	1058	5054	50540	47.7694
WEST RAVINE	.25	1058	0	0	0
WILBUR	.63	1058	11570	1340	1.26654
ZACHAU	.35	1058	0	0	0
COLUMB SONG	34.070		57215	115431	109.103
COLUMB HEARS	1.1347		1167.65	2355.73	2.22059

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 47 DEBRIS BASINS FOR 1955-56
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1955-56 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 2/COL 3)
ALTADENA	.51	2112	1161	2276	1.07765
AUGURN	.19	2112	1131	5952	2.81818
BAILEY	.6	2112	2748	4913	2.32623
BIG DARTON L	.34	2112	0	0	0
BRAVBURY	.68	2112	6510	9573	4.53267
BRAVO	1.03	2112	0	0	0
CARTER	.12	2112	1394	11583	5.48433
COOKS	.58	2112	0	0	0
DEER	.59	2112	0	0	0
DUNSMUIR	.84	2112	1184	1409	.66714
EAGLE	.61	2112	0	0	0
FAIRDOAKS	.21	2112	1242	4961	2.34896
FERN	.3	2112	400	1333	.631155
FLORAL UPPER	.06	2112	0	0	0
FLORAL LOWER	.11	2112	0	0	0
GOULD	.47	2112	2457	5231	2.47630
HAINEES	1.53	2112	0	0	0
HALLS	1.06	2112	4828	3792	1.79546
HAY	.2	2112	0	0	0
LANHAN	.25	2112	1420	5704	2.70076
LAS FLORES	.43	2112	0	0	0
LA TUNA	3.34	2112	16330	3122	1.49242
LINCOLN	.5	2112	0	0	0
HAUDOCK	.23	2112	3898	23232	11
MAY #1	.7	2112	1962	2802	1.32671
MAY #2	.69	2112	0	0	0
MCCLORE	.62	2112	4712	7603	3.59549
NICHOLS	.94	2112	449	477	.225822
PARADISE	.47	2112	2691	5725	2.7107
PICKENS	1.84	2112	4531	2446	1.15814
ROWLEY	.58	2112	0	0	0
ROBID	1.20	2112	0	0	0
RUBY UPPER	.21	2112	0	0	0
RUBY	.23	2112	0	0	0
SAWBIT	2.84	2112	9600	3330	1.60038
SCHOLL	.66	2112	0	0	0
SHIELDS	.27	2112	500	1851	.27642
SIERRA MADRE	2.39	2112	25904	10803	5.14347
SNOVER	.23	2112	0	0	0
SPARR	.64	2112	1872	2223	1.45492
STOUGH	1.65	2112	0	0	0
SUNSET UPPER	.44	2112	0	0	0
TUMBULL	.99	2112	0	0	0
VERDUGO	10.00	2112	12205	1204	.607955
WARD LOWER	.57	2112	1766	3133	1.48343
WEST XAVIER	.23	2112	0	0	0
WILBUR	3.63	2112	0	0	0
COLUMB SONS	33.629		113257	124900	59.1383
COLUMB MEANS	1.14035		2409.72	2057.45	1.25826

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 59 DEBRIS BASINS FOR 1954-55
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1954-55 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	1216	507	984	.805921
BAILEY	.6	1216	35783	59638	49.0444
BIG DALTON L	.34	1216	0	0	0
BRAND	1.03	1216	0	0	0
COOKS	.58	1216	2244	3860.	3.18092
DUNSMUIR	.84	1216	0	0	0
EAGLE	.01	1216	0	0	0
FAIROAKS	.21	1216	0	0	0
FERH	.3	1216	0	0	0
FLORAL UPPER	.30	1216	200	3333	2.74095
FLORAL LOWER	.11	1216	0	0	0
GOULD	.47	1216	0	0	0
HAINES	1.53	1216	0	0	0
HALLS	1.06	1216	0	0	0
HAY	.2	1216	0	0	0
LANNAN	.25	1216	7565	30260	24.8849
LAS FLORES	.45	1216	0	0	0
LINCOLN	.5	1216	0	0	0
MAY #1	.7	1216	0	0	0
MAY #2	.09	1216	0	0	0
MCCLORE	.62	1216	0	0	0
NICHOLS	.94	1216	0	0	0
PARADISE	.47	1216	837	1780	1.46382
PICKENS	1.04	1216	0	0	0
ROWLEY	.58	1216	1048	1820	1.43520
RUBIO	1.26	1216	0	0	0
RUBY UPPER	.21	1216	0	0	0
SCHULL	.66	1216	0	0	0
SHIELDS	.27	1216	0	0	0
SIERRA MADRE	2.37	1216	0	0	0
SNOVER	.23	1216	0	0	0
SPARR	.84	1216	0	0	0
STOUGH	1.05	1216	4002	2425	1.99424
SUNSET UPPER	.44	1216	0	0	0
TURNBULL	.99	1216	0	0	0
VERDUGO	19.05	1216	0	0	0
WARD LOWER	.57	1216	0	0	0
WEST Ravine	.25	1216	0	0	0
WILBUR	8.03	1216	553	64	.052632
COLUMN SUMS	43.354		52732	104154	85.6530
COLUMN MEANS	1.11103		1352.1	2670.62	2.19623

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 33 DEBRIS BASINS FOR 1953-54
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1953-54 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTA DENA	.51	2589	987	1778	.686752
BAILEY	.6	2589	0	0	0
BRAND	1.83	2589	0	0	0
COOKS	.58	2589	0	0	0
DUNSHUIR	.84	2589	0	0	0
EAGLE	.61	2589	0	0	0
FAIR OAKS	.21	2589	0	0	0
FERN	.3	2589	469	1533	.592121
GOULD	.47	2589	0	0	0
HAINES	1.53	2589	3620	2360	.913866
HALLS	1.86	2589	3313	3122	1.20587
HAY	.2	2589	0	0	0
LAS FLORES	.45	2589	0	0	0
LINCOLN	.5	2589	0	0	0
MAY #1	.7	2589	0	0	0
MAY #2	.89	2589	0	0	0
NICHOLS	.94	2589	1916	2838	.787177
PARADISE	.47	2589	0	0	0
PICKENS	1.84	2589	4332	2354	.909231
RUBIO	1.26	2589	0	0	0
RUBY UPPER	.21	2589	882d	34228	14.7655
SCHOLL	.66	2589	0	0	0
SHIELDS	.27	2589	7	25	9.65624E-3
SIERRA MADRE	2.39	2589	56992	23446	9.21051
SNOVER	.23	2589	0	0	0
SPARK	.34	2589	182d	1214	.468987
STOUGH	1.65	2589	0	0	0
SUNSET UPPER	.44	2589	0	0	0
TURNOLL	.99	2589	0	0	0
VERDUGO	1.885	2589	0	0	0
WARD LOWER	.57	2589	2880	3049	1.43942
WEST RAVINE	.25	2589	1011	4044	1.58199
WILBUR	8.63	2589	23440	2716	1.84965
COLUMN SUMS	41.373		187123	80913	33.5701
COLUMN MEANS	1.25364		3246.15	2633.73	1.31728

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 30 DEBRIS BASINS FOR 1952-53
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1952-53 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	731	1943	3809	5.21067
BAILEY	.6	731	0	0	0
BRAND	1.03	731	0	0	0
COOKS	.08	731	3	0	0
DUNSHUIR	.84	731	0	0	0
EAGLE	.61	731	2499	4096	5.60328
FAIRMOUNT	.21	731	0	0	0
FERN	.5	731	0	0	0
GOULD	.47	731	8073	17176	23.4966
HAINES	1.03	731	0	0	0
HALLS	1.06	731	0	0	0
HAY	.2	731	0	0	0
LAS FLORES	.45	731	0	0	0
LINCOLN	.5	731	0	0	0
NICHOLS	.74	731	0	0	0
PARADISE	.47	731	0	0	0
PICKENS	1.04	731	0	0	0
RUBIO	1.26	731	0	0	0
SCHOLL	.66	731	3070	4651	6.40356
SHIELDS	.27	731	0	0	0
SIERRA MADRE	2.59	731	0	0	0
SNOVER	.23	731	0	0	0
SPARR	.64	731	0	0	0
SLOUGH	1.05	731	0	0	0
SUNSET UPPER	.44	731	0	0	0
TURNBULL	.99	731	1307	1323	1.80575
VERUGO	10.05	731	14575	1052	1.43712
WARD LOWER	.57	731	2034	3553	4.88899
WEST KAVINE	.25	731	0	0	0
WILBUR	3.63	731	0	0	0
COLUMN SUMS	43.374		29521	35732	48.6399
COLUMN MEANS	1.54567		984.053	1190.07	1.6288

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 28 DEBRIS BASINS FOR 1951-52
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1951-52 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	7487	4176	8188	1.09363
BALLEY	.6	7487	276	460	.06144
BRAND	1.03	7487	5310	5155	.683527
BUNSMUIR	.84	7487	11025	13125	1.75384
EAGLE	.61	7487	2711	4444	.593502
FAIROAKS	.21	7487	3388	14704	1.96594
FERN	.5	7487	5397	17490	2.40233
GOULD	.47	7487	0	0	0
HAINES	1.55	7487	6164	4023	.537999
HALLS	1.06	7487	21880	20847	2.75771
HAY	.2	7487	1487	7435	.993455
LAS FLORES	.45	7487	1868	4151	.554424
LINCOLN	.5	7487	4543	8096	1.16148
NICHOLS	.94	7487	21704	23158	3.083318
PARADISE	.47	7487	7044	14907	2.041174
PICKENS	1.84	7487	13330	7247	.967444
RUBIO	1.26	7487	5154	4874	.544143
SCHULL	.60	7487	0	0	0
SHIELDS	.27	7487	13373	49529	6.61533
SIERRA MADRE	2.39	7487	5515	2387	.308134
SNOVER	.23	7487	2832	12315	1.66458
SPARR	.84	7487	4930	5869	.783592
STOUGH	1.65	7487	14452	8516	1.13744
SUNSET UPPER	.44	7487	3488	7727	1.83446
VERDUGO	12.85	7487	51036	5137	.680123
WARD LOWER	.57	7487	13585	23833	3.18525
WEST RAVINE	.25	7487	4465	17440	2.39613
WILBUR	6.63	7487	61687	7147	.954583
COLUMN SUMS	38.88		298514	298807	39.9101
COLUMN MEANS	1.36571		16575.5	16671.7	1.42536

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 28 DEBRIS BASINS FOR 1954-51
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1951-51 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	27	1481	21.19	78.4815
BAILEY	.6	27	0	0	0
BRAND	1.03	27	0	0	0
DUNSMUIR	.84	27	0	0	0
EAGLE	.61	27	0	0	0
FAIRDAKS	.21	27	0	0	0
FERN	.3	27	0	0	0
GOULD	.47	27	0	0	0
HAINES	1.53	27	0	0	0
HALLS	1.06	27	0	0	0
HAY	.2	27	0	0	0
LAS FLORES	.45	27	0	0	0
LINCOLN	.5	27	0	0	0
NICHOLS	.74	27	0	0	0
PARADISE	.47	27	0	0	0
PICKENS	1.34	27	0	0	0
RUBIO	1.26	27	0	0	0
SCHOLL	.66	27	0	0	0
SHIELDS	.27	27	0	0	0
SIERRA MAURE	2.37	27	0	0	0
SHOVER	.23	27	0	0	0
SPARR	.84	27	0	0	0
STOUGH	1.05	27	0	0	0
SUNSET UPPER	.44	27	0	0	0
VERDUGO	10.35	27	0	0	0
WARD LOWER	.57	27	0	0	0
WEST RAVINE	.25	27	0	0	0
WILBUR	6.03	27	0	0	0
COLUMN SUMS	38.50		1401	21.19	78.4815
COLUMN MEANS	1.33571		58.6071	75.6706	2.80291

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 26 DERRIS BASINS FOR 1949-54
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1949-54 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 3/COL 5)
ALTADENA	.51	151	1657	3249	21.5156
BAILEY	.6	151	0	0	0
BRAND	1.03	151	0	0	0
DUNSMUIR	.84	151	0	0	0
EAGLE	.61	151	0	0	0
FAIRBANKS	.21	151	0	0	0
FERN	.3	151	0	0	0
GOULD	.47	151	0	0	0
HAINES	1.53	151	0	0	0
HALLS	1.06	151	0	0	0
HAY	.2	151	0	0	0
LAS FLORES	.45	151	0	0	0
LINCOLN	.5	151	0	0	0
NICHOLS	.46	151	1210	1287	8.52318
PARADISE	.47	151	0	0	0
PICKENS	1.84	151	0	0	0
RUBIN	1.26	151	0	0	0
SCHULL	.00	151	0	0	0
SHIELDS	.27	151	0	0	0
SICKRA MAONE	2.39	151	0	0	0
SHOVER	.23	151	0	0	0
SPARK	.64	151	0	0	0
STOUGH	1.05	151	0	0	0
SUNSET UPPER	.44	151	0	0	0
VERJUGO	1.05	151	0	0	0
WARD LOWER	.57	151	1147	2012	13.3245
WEST RAVINE	.25	151	0	0	0
WILBUR	0.03	151	1870	216	1.43046
COLUMN SUMS	33.30		5334	6764	41.7947
COLUMN MEANS	1.38571		210.143	241.571	1.59931

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 28 DEBRIS BASINS FOR 1948-49
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1948-49 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTAVENA	.51	148	1413	2783	18.7833
BAILY	.6	148	0	0	0
BRAND	1.03	148	0	0	0
DUNSMUIR	.04	148	0	0	0
EAGLE	.61	148	0	0	0
FAIRHOAKS	.21	148	0	0	0
FERN	.3	148	0	0	0
GOULD	.47	148	0	0	0
HAINES	1.53	148	0	0	0
HALLS	1.06	148	0	0	0
HAY	.2	148	0	0	0
LAS FLORES	.45	148	0	0	0
LINCOLN	.5	148	0	0	0
NICHOLS	.94	148	588	625	4.22297
PARADISE	.86	148	157	182	1.22973
PICKENS	1.84	148	0	0	0
RUBIO	1.26	148	0	0	0
SCHULL	.66	148	0	0	0
SHIELDS	.27	148	0	0	0
SIERRA MADRE	2.39	148	0	0	0
STOVER	.23	148	0	0	0
SPARK	.84	148	0	0	0
STOUGH	1.65	148	0	0	0
SUNSET UPPER	.44	148	0	0	0
VERDUGO	10.05	148	0	0	0
WARD LOWER	.57	148	367	643	4.34460
WEST RAVINE	.23	148	0	0	0
WILBUR	8.63	148	3277	379	2.56381
COLUMN SUMS	39.190		5887	4639	31.1419
COLUMN MEANS	1.39964		207.393	164.607	1.11221

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 27 DEBRIS BASINS FOR 1947-48
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1947-48 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	288	2012	3945	13.6979
BAILEY	.6	288	0	0	0
BRAND	1.03	288	0	0	0
DUNSHUIR	.84	288	0	0	0
EAGLE	.61	288	71	114	.402178
FAIROAKS	.21	288	6	28.	.097222
FERN	.3	288	0	0	0
HAINES	1.53	288	0	0	0
HALLS	1.06	288	0	0	0
HAY	.2	288	0	0	0
LAS FLORES	.45	288	0	0	0
LINCOLN	.5	288	0	0	0
NICHOLS	.94	288	448	468	1.025
PARADISE	.93	288	212	227	.783194
PICKENS	1.84	288	436	236	.819444
RUPIN	1.26	288	0	0	0
SCHOLL	.66	288	0	0	0
SHIELDS	.27	288	0	0	0
SIERRA MADRE	2.39	288	0	0	0
SNOWY	.23	288	0	0	0
SPARR	.84	288	0	0	0
STOUGH	1.65	288	0	0	0
SUNSET UPPER	.44	288	0	0	0
VERDUGO	10.35	288	0	0	0
WARD LOWER	.57	288	1036	1817	6.30903
WEST RAVINE	.25	288	8	32	.111111
WILBUR	8.63	288	6956	886	2.79801
COLUMN SUMS	38.798		11177	7675	26.6493
COLUMN MEANS	1.43067		413.963	284.259	.967811

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 20 DEBRIS BASINS FOR 1946-47.
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1946-47 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
ALTADENA	.51	987	1401	2747	2.78318
BAILEY	.6	987	0	0	0
BRAND	1.03	987	143	138	.139218
DUNSHUIR	.84	987	0	0	0
EAGLE	.61	987	402	659	.66768
FAIROAKS	.21	987	661	3147	3.18345
FERN	.3	987	217	723	.732523
HAINES	1.53	987	922	602	.609929
HALLS	1.00	987	4459	4200	4.26140
HAY	.2	987	0	0	0
LAS FLORES	.45	987	480	1056	1.085004
LINCOLN	.5	987	1611	3222	3.20444
NICHOLS	.94	987	5047	6137	6.086612
PARADISE	1.35	987	1540	1472	1.49139
PICKENS	1.84	987	1096	595	.602357
RUSTO	1.26	987	684	542	.547139
SCHOLL	.60	987	082	1033	1.086661
SHIELDS	.27	987	21	77	.078014
SIERRA MAURE	2.39	987	1134	474	.480243
SNOVER	.23	987	122	530	.530981
STOUGH	1.65	987	0	0	0
SUNSET UPPER	.44	987	0	0	0
VERDUGO	10.05	987	392	39	.039514
WAND LOWER	.57	987	2736	4803	4.86322
WEST RAVINE	.25	987	011	2444	2.47019
WILBUR	8.03	987	12041	1464	1.48328
COLUMN SUMS	58.476		37608	35987	36.4610
COLUMN MEANS	1.46423		1446.46	1384.12	1.40235

LOS ANGELES WATERSHED SYSTEM (LAWS)
DEBRIS PRODUCTION OF 25 DEBRIS BASINS FOR 1945-46
DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1945-46 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BAILEY	.6	829	776	1293	1.55971
BRAND	1.03	829	0	0	0
DUNSMUIR	.84	829	2204	2623	3.16485
EAGLE	.61	829	300	491	.59228
FAIROAKS	.21	829	961	4576	5.5199
FERN	.3	829	1332	4440	5.35585
HAINES	1.03	829	461	301	.363038
HALLS	1.06	829	1716	1618	1.95175
HAY	.2	829	0	0	0
LAS FLORES	.45	829	637	1520	1.84077
LINCOLN	.5	829	0	0	0
NICHOLS	.94	829	221	235	.283474
PARADISE	1.05	829	1427	1357	1.63932
PICKENS	1.84	829	669	363	.437877
RUBIO	1.26	829	4350	3452	4.16405
SCRULL	.66	829	0	0	0
SHIELDS	.27	829	458	1696	2.04534
SIERRA MAURE	2.39	829	0	0	0
SNOVER	.25	829	0	0	0
STOUGH	1.65	829	0	0	0
SUNSET UPPER	.44	829	144	327	.394451
VERDUGO	10.05	829	0	0	0
WARD LOWER	.57	829	927	1626	1.90140
WEST KAVINE	.25	829	637	2548	3.07358
WILBUR	8.63	829	13868	1606	1.93727
COLUMN SUMS	37.560		31138	34080	36.2347
COLUMN MEANS	1.5024		1245.52	1205.20	1.45139

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 25 DEBRIS BASINS FOR 1944-45
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1944-45 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.83	1300	0.	0	0
DUNSMUIR	.84	1306	766	911.	.666911
EAGLE	.61	1300	1086	1780	1.30303
FAIROAKS	.21	1360	573	2752	2.01404
FERN	.3	1300	1470	4920	3.60176
HAINES	1.53	1366	0	0	0
HALLS	1.36	1366	5877	4789	3.50586
HAY	.2	1366	497	2485	1.81918
LAS FLORES	.45	1306	681.	1513	1.10761
LINCOLN	.5	1306	203	406	.297218
NICHOLS	.94	1366	303	322	.235725
PARADISE	1.85	1306	1831	1743	1.27599
PICKENS	1.84	1366	1504	817	.598097
RUBIO	1.26	1366	0	0	0
SHIELDS	.27	1366	233	862	.63104
SIERRA MAURE	2.39	1366	186	771	.656369
SNOVER	.23	1306	491	2134	1.56223
STOUGH	1.65	1306	4678	2835	2.0754
SUNSET UPPER	.44	1306	124	281.	.20571
VERDUGO	10.05	1306	20424	2032	1.43756
WARD LOWER	.57	1306	297	521.	.381406
WEST RAVINE	.25	1306	321.	1284	.939971
WILBUR	8.65	1306	8841.	1024	.749634
COLUMN SUMS	36.30		49597	33458.	24.5154
COLUMN MEANS	1.57826		2156.39	1456	1.06589

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 20 DEBRIS BASINS FOR 1943-44
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1943-44 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.23	4231	522	312	.074741
DUNSMUIR	.84	4231	3838	4023	1.09383
EAGLE	.61	4231	4525	7415	1.75325
FAIROAKS	.21	4231	524	2495	.587695
FERH	.3	4231	13617	45394	10.7284
HAINES	1.53	4231	6394	4182	.938419
HALLS	1.06	4231	8261	7743	1.84188
MAY	.2	4231	211	1655	.24935
LAS FLORES	.45	4231	2692	5982	1.41385
LINCOLN	.5	4231	1866	3732	.82061
NICHOLS	.74	4231	724	770	.18194
PICKENS	1.84	4231	6697	4030	1.14249
SHIELDS	.27	4231	1009	3737	.883243
SIERRA MADRE	2.39	4231	1441	602	.142283
SNOVER	.25	4231	0	0	0
STOUGH	1.05	4231	11703	7842	1.07620
SUNSET UPPER	.44	4231	1181	2664	.634365
VERUGU	10.05	4231	31045	3103	.748759
WEST RAVINE	.25	4231	4833	19212	4.54077
WILBUR	8.63	4231	37519	4347	1.02742
COLUMN SUMS	33.428		141429	129435	30.5921
COLUMN MEANS	1.671		7071.45	6471.75	1.5296

TIME : .134

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 20 DEBRIS BASINS FOR 1942-43
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1942-43 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.03	11277	3100	3009	.260826
DUNSMUIR	.84	11277	14007	16675	1.47807
EAGLE	.61	11277	15781	25870	2.29435
FAIROAKS	.21	11277	2774	13304	1.17975
FERN	.3	11277	0	0	0
HAINES	1.53	11277	29647	19377	1.71828
HALLS	1.06	11277	40333	45597	4.04336
HAY	.2	11277	3254	15270	1.35408
LAS FLORES	.45	11277	12759	28353	2.51423
LINCOLN	.5	11277	12449	20890	1.85315
NICHOLS	.94	11277	2996	3187	.282611
PICKENS	1.84	11277	53585	29122	2.58242
SHIELDS	.27	11277	5444	24148	1.78665
SIERRA MADRE	2.59	11277	6824	2555	.22317
SHOVER	.23	11277	6159	26821	2.37833
STOUGH	1.05	11277	29577	17925	1.58952
SUNSET UPPER	.44	11277	0	0	0
VERMILION	10.05	11277	78378	7798	.691496
WEST RAVINE	.25	11277	9884	39536	3.50598
WILBUR	8.63	11277	44127	5113	.453401
COLUMN SUMS	33.420		376904	340858	30.2259
COLUMN MEANS	1.671		18845.2	17442.9	1.51158

TIME : .233

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 14 DEBRIS BASINS FOR 1941-42
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1941-42 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.03	4233	0	0	0
DUNSMUIR	.84	4233	336	430.	.094490
EAGLE	.61	4233	0	0	0
FAIROAKS	.21	4233	0	0	0
FERN	.3	4233	0	0	0
HAINES	1.53	4233	0	0	0
HALLS	1.20	4233	0	0	0
HAY	.2	4233	0	9.	0
LAS FLORES	.45	4233	0	0	0
LINCOLN	.5	4233	0	0	0
NICHOLS	.44	4233	24105	25643	6.05788
PICKENS	1.84	4233	0	0	0
SHIELDS	.27	4233	0	0	0
SIERRA MADRE	2.39	4233	0	0	0
SNOVER	.23	4233	0	0.	0
STOUGH	1.05	4233	0	0.	0
SUNSET UPPER	.44	4233	12358	28080	6.63591
VERDUGO	10.05	4233	67471	6703	1.59769
WEST KAVINE	.25	4233	174	716	.169147
COLUMN SUMS	24.790		104949	61603	14.5542
COLUMN MEANS	1.54474		5523.63	3242.53	.766011

TIME . 0178

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 14 DEBRIS BASINS FOR 1940-41
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1940-41 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.03	10127	1055	1424	0.101116
DUNSHOIR	0.84	10127	11847	14105	1.39261
EAGLE	0.61	10127	13345	22096	2.024114
FAIROAKS	0.21	10127	3990	19000	1.37617
FERN	0.3	10127	4500	16000	1.57994
HAINES	1.53	10127	12534	8205	0.81021
HALLS	1.06	10127	48711	45253	4.53767
HAY	0.2	10127	615	3075	0.303644
LAS FLORES	0.45	10127	0	0	0
LINCOLN	0.5	10127	11704	23528	2.32329
NICHOLS	0.94	10127	0	0	0
PICKENS	1.04	10127	34437	10715	1.84803
SHIELDS	0.27	10127	9444	34977	3.45334
SIERRA MADRE	2.34	10127	0	0	0
SNYDER	0.23	10127	3312	14400	1.42194
STOUGH	1.05	10127	0	0	0
SUNSET UPPER	0.44	10127	0	0	0
VERUGO	10.35	10127	85077	8564	0.84566
WEST RAVINE	0.25	10127	8610	34464	3.40318
COLUMN SUMS	24.740		251067	204704	26.1384
COLUMN MEANS	1.30474		13214.1	13931.0	1.37571

TIME : .194

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 18 DEBRIS BASINS FOR 1939-40
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1939-40 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.83	2323	4827	4686	2.01722
DUNSMUIR	.84	2323	22072	26276	11.3112
EAGLE	.61	2323	0	0	0
FAIRWAYS	.21	2323	0	0	0
FERN	.3	2323	0	0	0
HAINES	1.53	2323	11425	7467	3.21438
HALLS	1.00	2323	0	0	0
HAY	.2	2323	184	920	.39644
LAS FLORES	.45	2323	0	0	0
LINCOLN	.5	2323	1188	2376	1.02232
NICHOLS	.94	2323	0	0	0
PICKENS	1.84	2323	13565	7372	3.17348
SHIELDS	.27	2323	0	0	0
SIERRA MADRE	2.39	2323	0	0	0
SNOVER	.23	2323	0	0	0
SUNSET UPPER	.44	2323	0	0	0
VERDUGO	10.05	2323	0	0	0
WEST KAVINE	.25	2323	504	2016	.857843
COLUMN SUMS	23.140		53765	51113	22.003
COLUMN MEANS	1.28556		2980.94	2837.61	1.22239

TIME : .162

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 18 DEBRIS BASINS FOR 1938-39
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1938-39 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.03	1976	0	0	0
DUNSMUIR	.84	1976	0	0	0
EAGLE	.61	1976	5936	9731	4.92469
FAIROAKS	.21	1976	0	0	0
FERN	.3	1976	0	0	0
HAINES	1.53	1976	0	0	0
HALLS	1.06	1976	0	0	0
HAY	.2	1976	2031	10155	5.13917
LAS FLORES	.45	1976	1112	2471	1.25051
LINCOLN	.5	1976	0	0	0
NICHOLS	.94	1976	0	0	0
PICKENS	1.04	1976	0765	4763	2.41343
SHIELDS	.27	1976	4390	16259	8.22424
SIENRA MADRE	2.39	1976	0	0	0
SNOWY	.23	1976	21091	91700	46.4069
SUNSET UPPER	.44	1976	0	0	0
VERDUGO	10.05	1976	0	0	0
WEST RAVINE	.25	1976	2403	9612	4.86437
COLUMN SUMS	23.140		45724	144691	73.2242
COLUMN MEANS	1.28556		2540.44	8036.39	4.00801

TIME : .278

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 18 DEBRIS BASINS FOR 1937-38
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1937-38 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.03	33374	0	0	0
BUNSLAIR	.84	33374	78216	93114	2.79202
EAGLE	.61	33374	41690	68344	2.04732
FAIROAKS	.21	33374	12639	60185	1.80335
FERN	.3	33374	21153	70526	2.1132
MAINES	1.53	33374	51505	33663	1.00866
HALLS	1.00	33374	108125	102404	3.05639
HAY	.2	33374	20993	104290	3.14586
LAS FLORES	.45	33374	55400	123288	3.62415
LINCOLN	.5	33374	10061	20122	.002924
NICHOLS	.94	33374	0	0	0
PICKENS	1.84	33374	122197	66411	1.9899
SHIELDS	.27	33374	35147	130174	3.90846
SIERRA MADRE	2.39	33374	63162	26427	.791844
SNOVER	.23	33374	16089	72554	2.17415
SUNSET UPPER	.44	33374	0	0	0
VERJUGO	10.05	33374	105364	10483	.314107
WEST RAVINE	.25	33374	29800	119404	3.57455
COLUMN SUMS	23.140		772277	1.10176E+6	
COLUMN MEANS	1.28556		42985.4	61208.6	1.83402

33.0124

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 15 DERRIS BASINS FOR 1936-37
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1936-37 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.03	5657	0	0	0
DUNSMUIR	.84	5657	0	0	0
EAGLE	.61	5657	0	0	0
FAIROAKS	.21	5657	14611	69576	12.2991
FERN	.3	5657	21456	71528	12.6427
HAINES	1.53	5657	0	0	0
HALLS	1.46	5657	28281	26680	4.71628
HAY	.2	5657	0	0	0
LAS FLORES	.45	5657	0	0	0
LINCOLN	.5	5657	28289	40418	7.14478
PICKENS	1.94	5657	28454	18543	1.86371
SIERRA MAURE	2.39	5657	0	0	0
SUNSET UPPER	.44	5657	0	0	0
VERDUGO	10.35	5657	0	0	0
WEST RAVINE	.25	5657	18316	73264	12.951
COLUMN SUMS	21.80		123327	292001	51.6176
COLUMN MEANS	1.45333		8221.80	19466.71	3.44118

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 12 DEBRIS BASINS FOR 1955-56
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1955-56 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
BRAND	1.83	5689	0	0	0
DUNSMUIR	.84	5689	942	1121.	.197847
FAIROAKS	.21	5689	15711	74814	13.1546
FERI	.3	5689	12492	41300	7.26566
HALLS	1.46	5689	23327	22478.	3.96552
LAS FLORES	.45	5689	10532	23626	4.15293
LINCOLN	.5	5689	7858	15916	2.79763
PICKENS	1.94	5689	32547	16777.	2.94902
SIERRA MADRE	2.37	5689	0	0.	0
SUNSET UPPER	.44	5689	0	0.	0
VERDUGO	13.85	5689	0	0	0
WEST RAVINE	.25	5689	7201	28804	5.0631
COLUMN SUMS	19.46		118724	224486	39.4456
COLUMN MEANS	1.62167		9227	18733.5	3.28713

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 4 DEBRIS BASINS FOR 1934-35
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1934-35 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
DUNSMUIR	.84	3085	0	0	0
SIERRA MADRE	2.37	3065	0	0	0
SUNSET UPPER	.44	3085	0	0	0
WEST RAVINE	.25	3085	12095	48380	15.6823
COLUMN SUMS	3.92		12095	48380	15.6823
COLUMN MEANS	.98		3023.75	12095	3.92058

LOS ANGELES WATERSHED SYSTEM (LAWS)
 DEBRIS PRODUCTION OF 2 DEBRIS BASINS FOR 1933-34
 DATA PROVIDED BY THE L.A. COUNTY FLOOD CONTROL DISTRICT

(1) CANYON NAME	(2) AREA (SQ MI)	(3) 1933-34 LAWS (CU YD/SQ MI)	(4) YIELD (CU YD)	(5) RATE (CU YD/SQ MI)	(6) INDEX (COL 5/COL 3)
DIVIDE OVERFLOW IN 218					
SIERRA MAYRE 2.39		0	0	0	1.70141E+38
DIVIDE OVERFLOW IN 218					
FLOATING OVERFLOW IN 217					
SUNSET UPPER .44		0	0	0	1.70141E+38
COLUMN SUMS 2.83			0	0	1.70141E+38
COLUMN MEANS 1.415			0	0	8.50706E+37

TIME : .073

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